June, 1930

Railway Engineering and Maintenance

RAILWAY ENGINEERING AND MAINTENANCE
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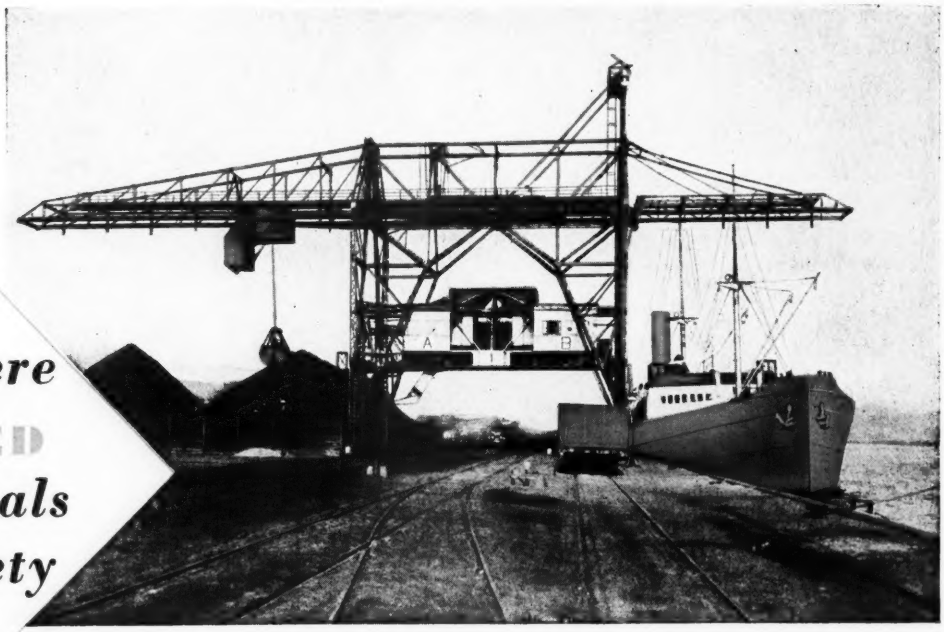
RESPON

• THE • RAILROAD • WORLD •

A *guard that says...*

Keep Out! Corrosion



where RED *signals safety*

RED LEAD *Safeguards* Metal!

THE blue-coated officer on his beat...the grim, gray dreadnaught of the deep...both are guardians of property. .both are symbols of protection.

In the same class, you can also place pure red lead... for it is the guardian of metal structures. It keeps out corrosion, the destructive agent which stealthily attacks unguarded metal structures.

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Your request will quickly bring you the booklet, "Structural Metal Painting" and you are also invited to consult our Department of Technical Paint Service. In either case, address the nearest branch.

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New York, 111 Broadway; Buffalo, 116 Oak Street; Chicago, 900 West 18th Street; Cincinnati, 659 Freeman Avenue; Cleveland, 820 West Superior Avenue; St. Louis, 722 Chestnut Street; San Francisco, 2240-24th Street; Boston, National-Boston Lead Co., 800 Albany Street; Pittsburgh, National Lead & Oil Co. of Penna., 316 Fourth Avenue; Philadelphia, John T. Lewis & Bros. Co., Widener Building.

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A combination of features no other railway crane or shovel has to offer!
NORTHWEST
NORTHWEST ENGINEERING COMPANY
The world's largest exclusive builders of gasoline, oil burning and electric powered shovels, cranes and draglines
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40% Almost half the crawler machines on American Railways are Northwests
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The Northwest crawler delivers positive traction even while turning, permitting rapid and easy travel from car to car, down ramps and over ground conditions impossible for the ordinary crawler.
All high speed shafts roll on roller bearings eliminating the power waste that comes with bronze and babbitt.
The engine is mounted on eliptical springs and drives through a flexible coupling eliminating the dangers of misalignment and damaging vibration.
The "feather-touch" control is the only one in which the action of the clutch is in direct proportion to the movement of the lever. It speeds up operation increasing the output 25%.
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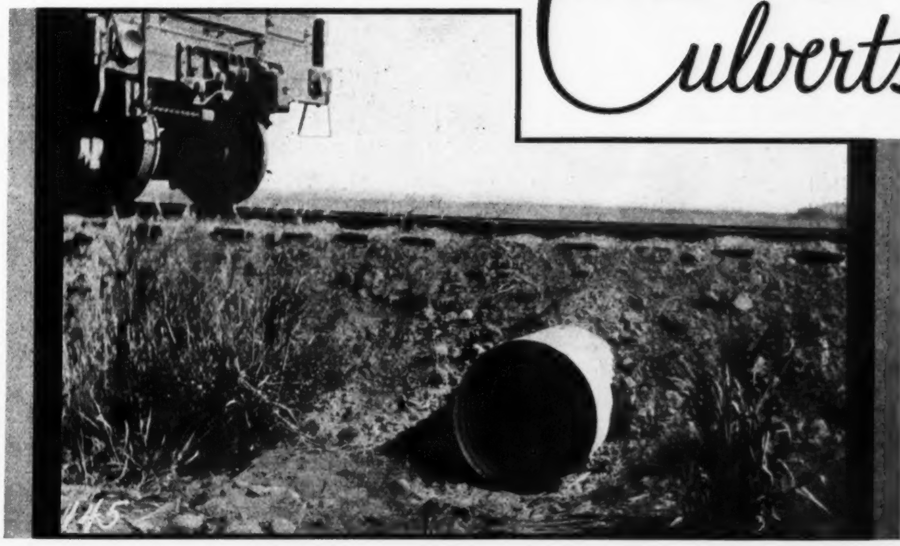
KEEPING PACE WITH PROGRESS
THE performance records of Neafie Rail Joints, in service on some of the major systems of the country, are demonstrating their worth as effective means of overcoming some of the common ills of track maintenance.
Let us show you how this device eliminates some of the forces that destroy ties, and how it makes spacing of the ties unnecessary when laying rail.
Try these joints in your own track and let results speak for themselves.
THE RAIL JOINT COMPANY
165 Broadway—New York

OFFICIALLY, *by the Test of Time, Nature has OK'd*

ARMCO *Culverts*



Under shallow fills and deep ones, in every State and Canada, hundreds of thousands of Armco Culverts are serving the railroads — keeping roadbeds dry, firm — safe for heavy, fast-moving traffic.

Choose them CONFIDENTLY

CLAIMS are not made for Armco Culverts. Facts—plain facts are recited—facts that need no verbal brass band to support them. Officially, by the test of time, Nature has OK'd Armco Culverts as the longest-lasting product of its kind in use.

Knowing the difference between facts of performance and laboratory "proofs" of potential or probable service, railroads select culverts with definite ease.

We say, simply, Armco Culverts, made uniformly pure since 1906, endure. We say they have endured for more than 24 years and that their true life expectancy is not yet known. Time will reveal their real durability.

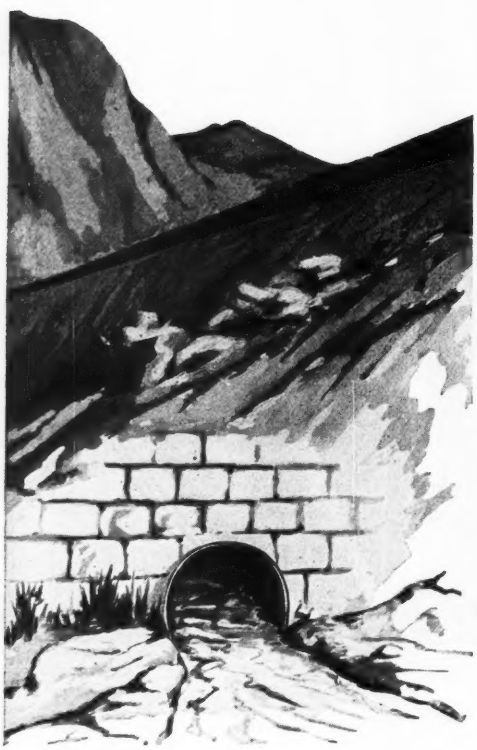
We say (or suggest), simply, choose Armco Culverts and save money. Because the longer life of Armco Culverts automatically means greater economy.

The swing to Armco Culverts is the natural result of the growing knowledge of the facts about culverts. For new data—recent facts assembled from field studies made by Armco engineers—write to Drainage Headquarters.

Armco culverts and drains are manufactured from the Armco Ingot Iron of The American Rolling Mill Company and always bear its brand.

ARMCO CULVERT MANUFACTURERS ASSOCIATION
Middletown, Ohio

Longer life . . .
Less maintenance
when culverts are made of Toncan Iron



As train speeds increase and freights become heavier, road bed protection grows more important. Water, the chief cause of soft spots, becomes a greater menace to safety. To remove it effectively is a job for which Toncan Iron Culverts are particularly well suited.

Possessing all the structural qualities—the strength and flexibility—that make corrugated culverts appropriate for this purpose, Toncan Iron Culverts also provide the added advantage of higher resistance to corrosion.

Because of the addition of copper and molybdenum to refined iron, Toncan Iron has extra resistance to destructive waters and soils. These elements give to Toncan Iron Culverts the longer life that has made them the choice of many railroads. By their effective drainage, culverts of Toncan Iron assist in keeping track maintenance costs low.

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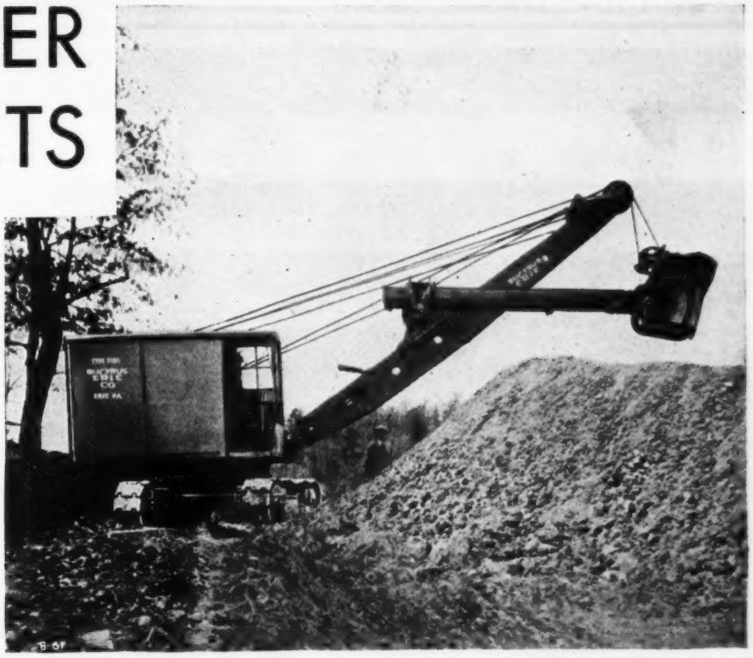
MANUFACTURERS' ASSOCIATION
MASSILLON, OHIO

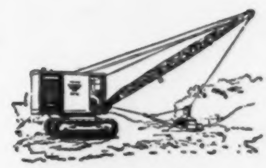
Plants Located in All Parts
of United States and Canada

TONCAN COPPER MO-LYB-DEN-UM **IRON**

CONSIDER THESE FACTS



BEFORE YOU BUY A ½ YARD SHOVEL



DO YOU KNOW that you can buy a 1/2-yard gasoline, Diesel or electric shovel, crane or dragline from the world's largest builders of excavating machinery? Built, in every way — materials, workmanship, design — to the same high standards as the big, powerful, rugged quarry and coal stripping shovels. - - - Born of actual field experience with over 10,000 machines operating in all classes of excavation in all parts of the world.

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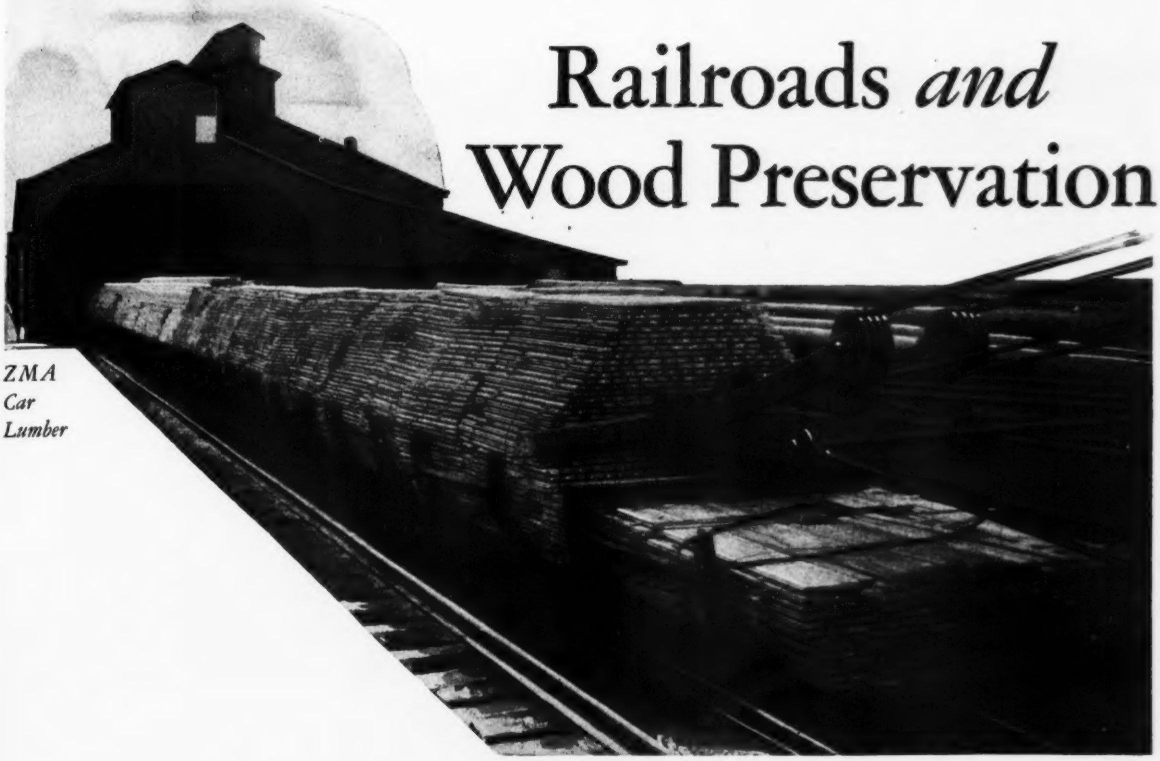
Railroads *and* Wood Preservation



ZMA Car Lumber

THE outstanding advantages to be derived by the use of preservative treatment to cross-ties, piling and bridge lumber, has been amply proved over a term of years by most railroads.

Wood preservation is solving the cross-tie supply problem. By proper treatment, most any species of wood may be made adaptable for cross-tie use.

Railroads continue to use millions of feet of untreated lumber for miscellaneous purposes. Great savings may be made on these large items of lumber now being used untreated. Freight cars, shipping platforms, fence posts, snow fences, station buildings, engine terminals—all should be treated against decay, and in many cases against termites.

ZMA is the one clean treatment which can be used by railroads for preservative treatment of miscellaneous lumber which is not now being treated. ZMA lumber can be used both for contact with the ground as well as for superstructures. It is the all-purpose clean preservative—odorless, permanent and paintable.

ZMA

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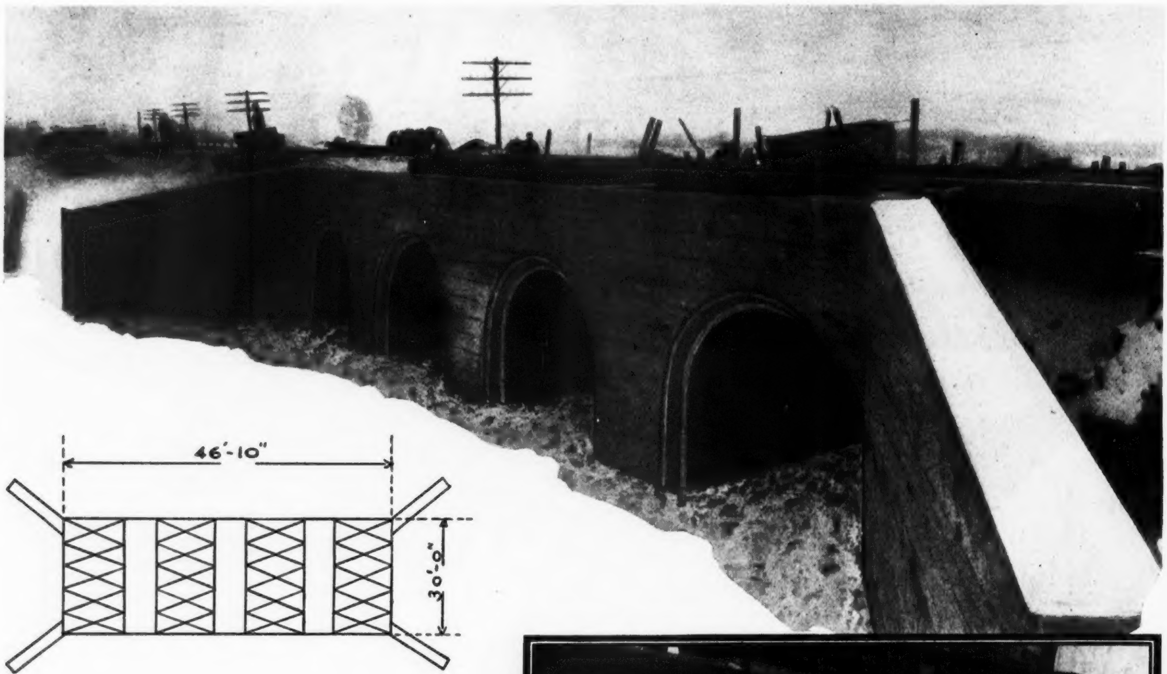

Ready *for the* Big Freshets

THESE four lines of 91" x 91" flat base Massey pipe will handle a lot of water. For streams subject to flood conditions this construction has obvious advantages. The use of precast pipe insures the highest quality concrete and minimum interference to traffic. Massey engineers will gladly discuss with you any special applications of concrete pipe, piling, cribbing, or houses. Descriptive catalogs on all Massey products sent on request.

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MASSEY
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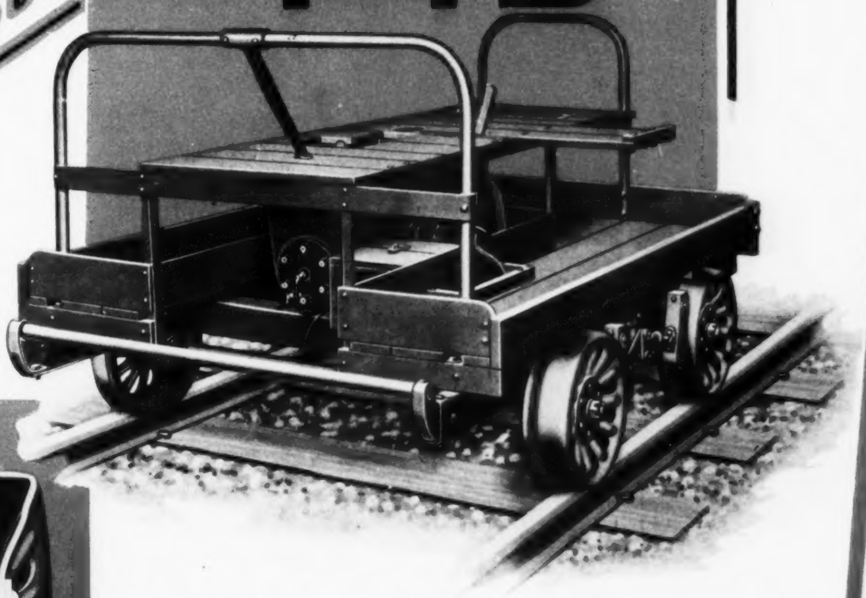
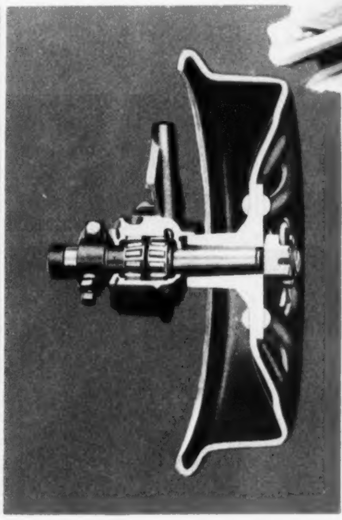
Peoples Gas Building, Chicago, Illinois

REM 6 Gray

"Sheffield 44B"





Timken Tapered-Roller Double Bearing Assembly and section of Sheffield Pressed Steel Wheel. Although the capacity of one bearing is far above actual requirements—two bearings are used in each axle box.

1930
begins the
SECOND CENTURY
of building
FAIRBANKS SCALES

What is back of the *"Sheffield"* record of performance?

Sheffield Motor Cars have built up a reputation for dependability and low cost operation that is indicated by the maintenance figures of the nation's railroads. What is back of this performance record?

First, *every* part of the Sheffield Motor Car is built to give maximum service. In not a single instance has quality been sacrificed to price. There are no weak links in the "Sheffield"—no cheapened construction that needs to be covered up by drawing attention to minor refinements. *Every* part of the car will stand the closest inspection.

(Continued on next page)

TIMKEN BEARING EQUIPPED

First on the rails . . . and still first

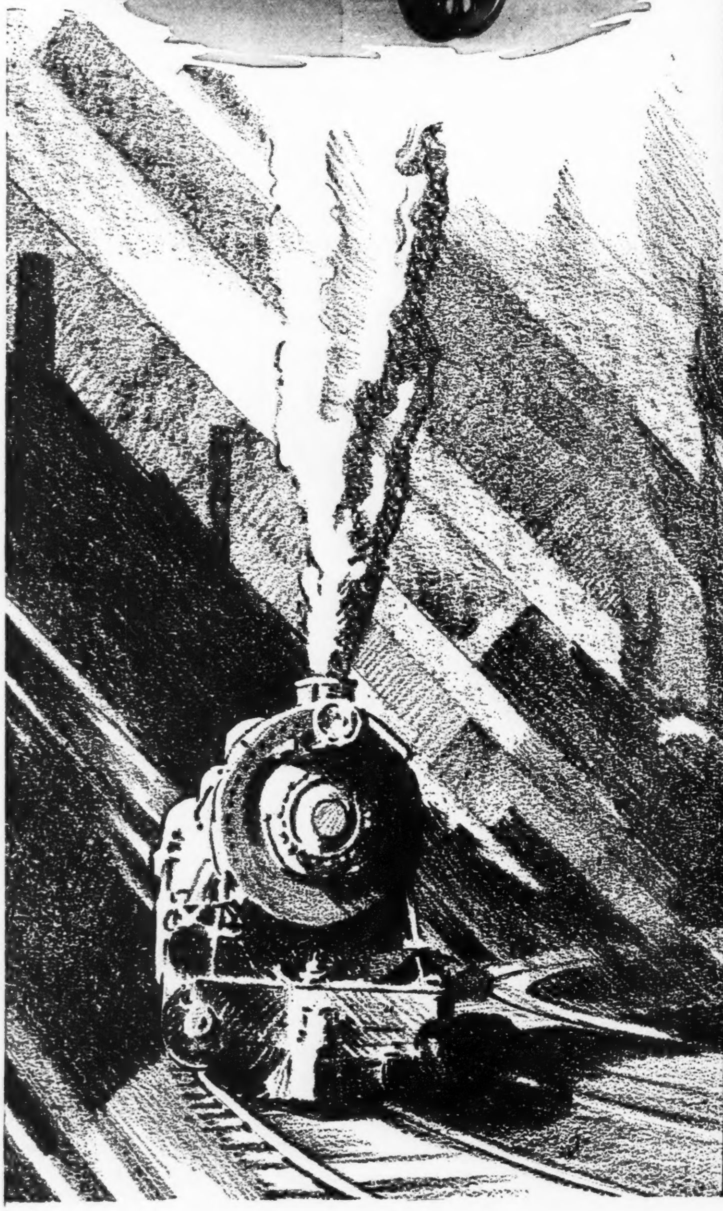
FAIRBANKS-MORSE MOTOR CARS

F M

Half as old as railroading, Itself

KALAMAZOO MEANS SERVICE TO YOU

ESTABLISHED 1883



Almost half a century of experience has gone into the development of the Kalamazoo Safety First One-Man Inspection Car, 216-L, illustrated at the left.

It is speedy and powerful—easy and economical to run lifted on and off the rails by one man—seats three men comfortably.

The simplicity of its design marks it as an outstanding example of unusual mechanical development. All parts are readily accessible. It is ruggedly built for years of hard service.

Supervisors, roadmasters, inspectors, signalmen, linemen, car repairmen, and operators all over the country are enthusiastic about this light-weight, powerful, dependable Kalamazoo Motor Car.

We will be pleased to send complete catalog information.

KALAMAZOO RAILWAY SUPPLY CO.

Manufacturers

Kalamazoo, Michigan

CARNEGIE BEAMS

for grade-crossing elimination work

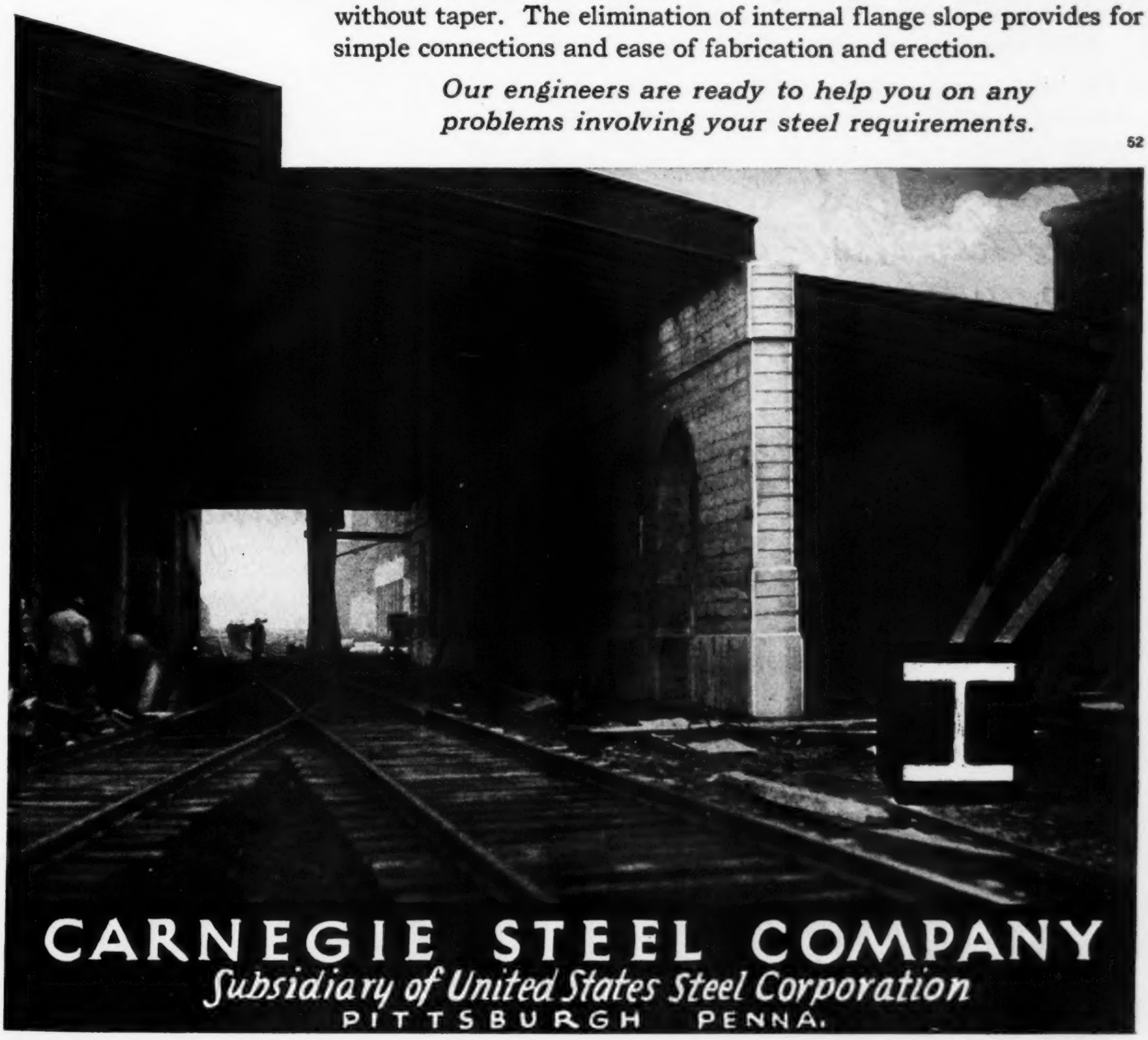
A simple and economical solution of the problems of highway and maintenance of way engineers engaged in grade separation work is offered by Carnegie Beams.

This series of sections comprises a full range of beam, girder and column sections of high efficiency as measured by the ratio of section modulus to the weight. The heavier sections, designed primarily for heavy loads on long spans with the least loss of head room, will prove especially valuable. These sections up to 36 inches deep, offer a wide selection of flange widths and section moduli as high as 1102.7 inches^3. They eliminate the fabrication necessary in built-up plate and angle girders.

Carnegie Beams are characterized by flanges of uniform thickness without taper. The elimination of internal flange slope provides for simple connections and ease of fabrication and erection.

Our engineers are ready to help you on any problems involving your steel requirements.

52



"The Best Machine on the Road"

These are the exact words of the foreman in charge of the job shown in these pictures.

"Saves 18 Men"

And he followed with this further statement about Nordberg Adzing Machines—

"Without the two Nordberg Adzing Machines we would require at least 18 men with hand adzes and I doubt very much whether they would be able to keep up with the rest of the gang"-----

BETTER WORK

"and with hand adzing we could not get the kind of job we are getting with the machines"

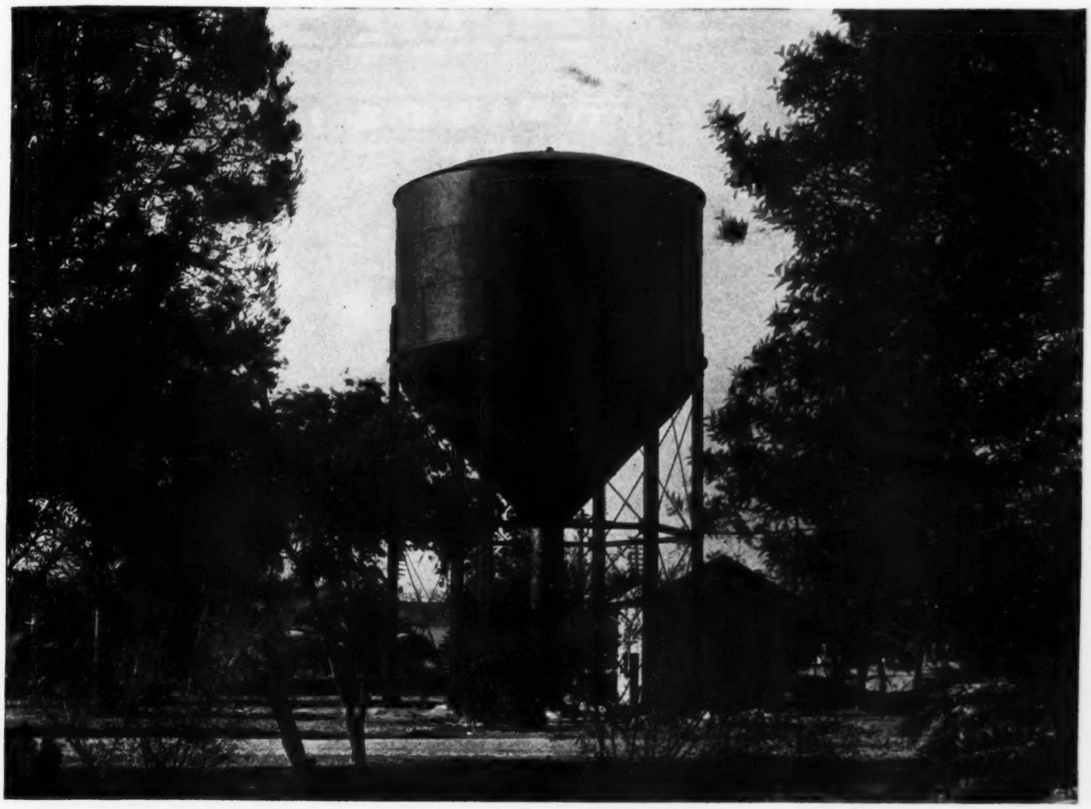
TO SUMMARIZE

Nordberg Adzing Machines are doing better work (Adzing every tie to the same plane), saving labor (18 men) and preventing delays which would otherwise hold up 90 men from doing a full day's work.

It is no wonder this gang easily completed 14,800 feet of perfectly laid rail in one day.

NORDBERG MFG. CO.
MILWAUKEE, WISCONSIN

NORDBERG ADZING MACHINE
SURFACES EVERY TIE TO EXACTLY THE SAME PLANE



200,000-gallon conical-bottom steel tank built for the Southern Pacific at Davis, California

The Age of Steel Tanks

This is the age of steel tanks. Railroad and other leading industries which determine the trend of the times are using them for water service, oil storage and fire protection.

Steel tanks always present a pleasing appearance. They are well designed and well proportioned structures. They retain their original condition. Regular painting keeps them like new. Accessories and portions of the structure such as the roof do not become loose or sag to give the structure a dilapidated appearance.

Engine districts have been lengthened, and heavy traffic has increased water needs. Steel tanks in large capacities are not only practical, but economical.

Elevated steel tanks for roadside delivery service are built with conical or ellipsoidal bottoms. Either type has a large steel riser, usually six feet in diameter. When muddy water is encountered, the sediment settles and collects in the bottom of the riser. From there it is easily flushed out of the tank through a quick-opening wash-out valve without taking the tank out of service.

Elevated steel tanks are also used for general water service and fire protection at terminals. They are built the proper height to give the required gravity pressure. Such a supply is always dependable, even though power may be interrupted or pumps shut down for repairs at intervals.

Write us for information on our products or estimating prices on installations you contemplate making.

Ask for a copy of this booklet

B-148

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New York	3156 Hudson Terminal Bldg.
Cleveland	2202 Union Trust Bldg.
Dallas	3309 Magnolia Bldg.
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Philadelphia	1609 Jefferson Bldg.
Atlanta	2136 Rhodes-Haverty Bldg.
San Francisco	1007 Rialto Bldg.
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HORTON TANKS

KREOLITE

Aerial View of Part of the Toledo Plant of The Jennison-Wright Company

Framing of Timbers "BEFORE" Treatment Is Essential

By the installation of the latest and most modern framing and boring machinery, we assure the purchaser of timbers most accurately framed at lowest cost.

The life of treated timber depends upon the character of the preservative used. *We distill our own Creosote oil.* By so doing it is possible for us to insure to the purchaser a uniform pure product of any grade desired.

Enormous stocks of Railroad Cross and Switch Ties, Structural Timbers and Piling, in all sizes, of Solid Oak or Pine, properly sticked and air seasoned before treatment, available for prompt shipment from Toledo, Ohio, or our Midland Creosoting Company plant, at Granite City, Ill. (East St. Louis).

THE JENNISON-WRIGHT COMPANY, TOLEDO, OHIO
Branches in All Large Cities

R.R. TIES

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Railway Engineering and Maintenance

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ADDRESS REPLY TO
105 WEST ADAMS ST.
CHICAGO, ILL.

Subject: Using Your Copy

May 29, 1930

Dear Reader:
Everywhere

If there is any one measure of the practical value of the material published in Railway Engineering and Maintenance which we as its editors consider more convincing than any other, it is that you think so well of an article that you call it to the attention of your associates. Whenever we learn of such action on your part we feel that our efforts have been well worth while.

Two letters have come to our attention during the last month that contain such evidence of the merit of articles appearing in our May issue. In the first of these letters, the chief maintenance officer of a prominent eastern road wrote his roadmasters as follows:

> "Please take up with your foremen the May, 1930, issue of Railway Engineering and Maintenance. Call their attention particularly to the article beginning on page 204 dealing with motor car accident prevention, also the article appearing on page 212 treating of snow handling."

Within the last week the chief engineer of a western road sent us copies of a photostatic reproduction that he had had made of a drawing that appeared on page 207 in the same issue, illustrating the proper way of operating a motor car approaching a highway crossing. "We are sending one of these pictures," he wrote, "to each of our section foremen and our bridge and building supervisors. We have experienced trouble from the failure of our men to observe the courtesy indicated in the picture."

We regard such letters as evidence that we are succeeding in at least some measure in our desire to be of practical help to you, our readers in the field. It occurs to us also that these letters may suggest to you ways in which you can increase the value of your subscription to Railway Engineering and Maintenance and use it to promote good railroading among your associates, if you are not already doing this.

Yours very truly,

Elmer T. Howson

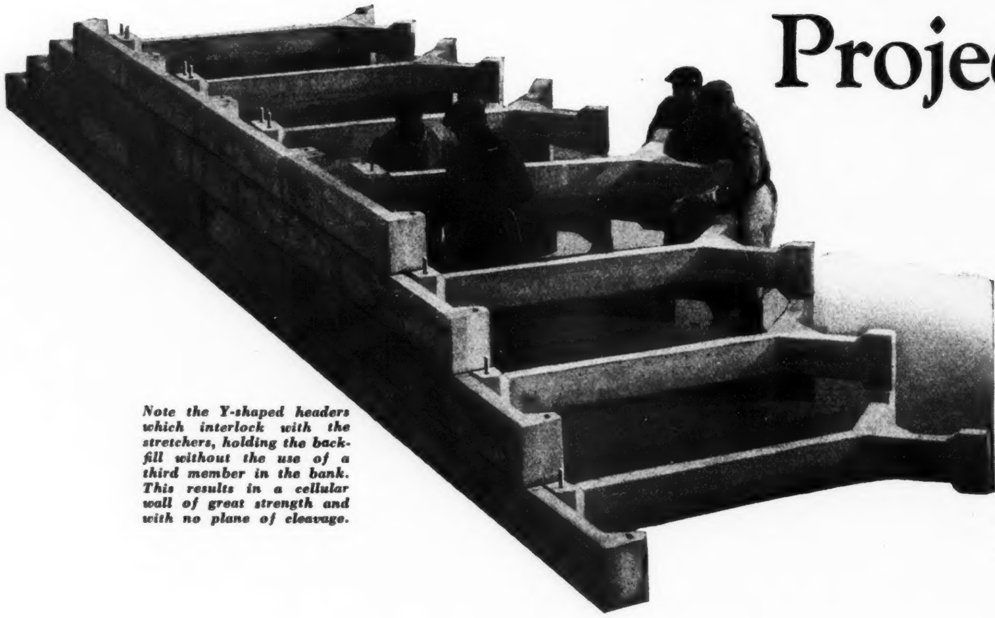
Editor.

ETH*MM

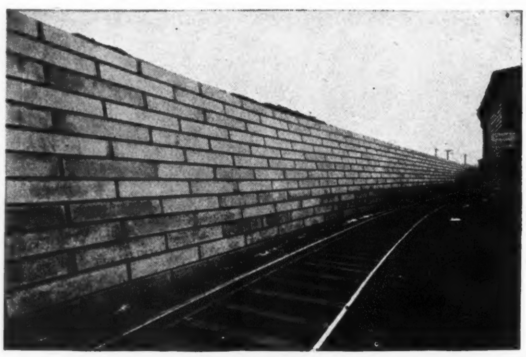
MEMBERS: AUDIT BUREAU OF CIRCULATIONS AND ASSOCIATED BUSINESS PAPERS, INC.


ORTON

On a Big Chicago Grade Separation Project



Note the Y-shaped headers which interlock with the stretchers, holding the back-fill without the use of a third member in the bank. This results in a cellular wall of great strength and with no plane of cleavage.



Showing the splendid closed face of a Federal retaining wall. It resembles fine masonry in appearance.

Federal Retaining Wall construction will be particularly advantageous on this new and important work.

Two walls, one on either side of the road bed, will serve not only to support the tracks solidly and permanently, but the closed-face beauty of the walls will enhance the appearance of the entire project.

With its added 2-piece economy in material and labor to erect—its complete absence of all maintenance costs—its speedy erection—100% salvage for re-location—Federal has impressed its value on engineers of the country's leading railroads. Send for booklet "The 2-Piece Retaining Wall."

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Concrete Products for Over 25 Years

FEDERAL 2 piece Concrete CRIBBING

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GEORGE E. BOYD, *Associate Editor*

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M. H. DICK, *Associate Editor*

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Entered at the postoffice at Chicago, Ill., as mail matter of the second class.

Railway Engineering and Maintenance

Volume 26 . June, 1930 No. 6

Classifying Track Scrap

IN THE PAST, little attention has been given to the classifying of scrap preparatory to shipping it from the sections. About all that has been required has been the segregation of the track scrap from the car and locomotive material which is picked up along the right-of-way, and the loading of these two classes of material in separate cars.

When cars that are loaded in this manner arrive at the storehouse their contents must be unloaded on sorting platforms, classified and reloaded when sold. This requires three handlings, the occupation of a considerable area by the sorting platforms and the provision of track facilities to serve the scrap piles. In many instances this practice also necessitates considerable unprofitable back haul when the sale is consummated.

In view of these considerations, one road recently experimented with the practice of having the section forces classify the track scrap before loading. The various classes were then loaded separately and when a car was filled, the stores department was notified, the load was sold and billed immediately to the purchaser. The experiment was so successful that this method of classifying and disposing of the track scrap has been adopted as standard practice.

This road finds that it takes little if any longer to classify the scrap, if this is done as it is collected, than it does to pick it up without classifying it. After a limited amount of instruction, the track forces are able to make the required classifications satisfactorily. The cost of two handlings is eliminated and the areas previously devoted to sorting platforms, storage and track facilities are available for other uses, while the cars which are used in scrap service are released for revenue loading.

The experience of this road would indicate that even in so simple an operation as the collection and shipment of scrap, there is a definite opportunity to effect material savings.

Capital Expenditures

During the first three months of 1930, the railways of the United States made capital expenditures aggregating $223,772,000 for additions and betterments to their equipment and roadway properties. This was $96,653,000 more than was spent for the same purpose during the corresponding period a year ago. Of this sum, $134,702,000, or 60 per cent, went for roadway and structures, an increase of $45,225,000 as compared with the first three months of 1929. These expenditures included $27,608,000 ($20,089,000)* for additional main and side tracks; $10,356,000 ($8,502,000) for heavier rail; $8,361,000 ($5,479,000) for shops and enginehouses and tools; $23,744,000 ($11,607,000) for station facilities and office buildings, and $15,801,000 ($12,572,000) for bridges, trestles and culverts. In this vigorous manner, the railways are making good the promise which they made to President Hoover last fall that they would not only continue their record-breaking program of the last seven years, for the improvement of their physical properties, but would increase it more than 25 per cent.

More Native Labor

HOW serious is our national problem of unemployment? That a great many people are now out of work is well known, but there are those who contend that there was much involuntary unemployment during the height of the industrial activity of 1929. Estimates of unemployment published at that time lacked definiteness and were discounted by some authorities. Nevertheless, these estimates have given rise to the rather generally accepted conclusion that the widespread application of labor-saving machinery has imposed a national problem of serious import. The effect of this has been a movement for a further restriction of immigration, one proposal being to cut the quotas now fixed by law, and another to effect a rather drastic curtailment of immigration from Mexico and other American countries.

Whether or not some means for the further restriction of immigration will be incorporated in the statute, one thing is certain. There will be no increase in the annual influx of foreign peoples for many years to come, and the foreigner as a factor in track labor supply will be even less important than he is today.

Another influence affecting the supply of track labor is becoming increasingly apparent as the census figures are being announced from day to day. This is the declining population of the small town. In fact, it is only the towns that come within the zones of influence of industrial centers that show any appreciable growth. Stationary or declining population is indicative of declining opportunities for employment and bears out the experience of maintenance of way officers that in most parts of the country adequate section forces can now be recruited from the residents of the local community.

The influences of declining immigration and of a larger supply of native labor are also apparent in the complexion of extra gangs, although in these the

*Figures in parentheses are for the corresponding period of last year.

foreign element is still largely represented by the Mexican. A curtailment of immigration from Mexico would curb the last remaining source of foreign labor.

Advances in Building Practices

MUCH has been said concerning the changing duties and increasing responsibilities which fall to the lot of the maintenance of way officer by reason of the transition from manual to power operations. This thought has been stressed particularly in discussing the responsibilities of the officers of track because of the greater application of labor-saving devices in track maintenance than in the upkeep of bridges and buildings. It would seem, however, that the march of progress has exerted as great an influence on the work of the bridge and building man, although in his field the influence arises primarily from the introduction of new materials and appliances that are applied to or enter into the structures rather than devices employed to carry out or aid construction.

The influence of the steel frame and of reinforced concrete on bridge and building construction has been stressed so often that mere mention will suffice here, and in so far as bridges are concerned they tell almost the entire story. It is in the field of buildings that the officer of structures is confronted with a multiplicity of developments which are taking place so rapidly that he must be constantly on the alert if he is to keep abreast of current progress.

This is aptly illustrated in changing methods of heating locomotive and car facilities. Thus, the forced draft hot-air system was in common use 15 years ago, yet some roads had hardly adopted it when the unit heater entered the field. Fifteen years ago some officers in charge of buildings had so little confidence in saw-tooth roofs or skylights that they hesitated to use them in car paint shops or other structures where a leak is an exceedingly serious matter. Today, the weather-tightness of well-known makes of overhead lights is accepted almost without question. As a matter of fact, 15 years almost covers the use of steel sash in railway buildings. It embraces the period of the extensive use of unit-type roof coverings other than the wood shingle or slate.

More recently, progress has been more rapid in the field of metallurgy, and the building officer is confronted with a confusing array of new materials or new adaptations of old ones. Chromium competes with nickel in the plating of the brass pipes for plumbing fixtures. A corrosion-resisting alloy is now being offered in high polished sheets at a price that permits its use as an exterior covering for the more costly buildings. Copper-bearing steel is being adapted to structural use, and even aluminum plates and shapes are now available for similar applications, while ornamental tiles of the same material are being applied for decorative use

The work of the research laboratory has been productive of new materials for various uses in building construction and maintenance. Among these are new paints or other surface coatings, including those designed for protection against corrosion. Still another important field is to be found in products available for heat and sound insulation.

It is not to be inferred from this that all these newer products are without their limitations, or that they will at once completely supplant materials of longer application with which they compete. But where the builder's choice was once confined to two or three materials for a given purpose, he now has perhaps a dozen, some of which possess properties vastly different from those of the products with which he is thoroughly familiar through long experience. Intelligent selection is, therefore, much more difficult and calls for a wider range of knowledge that can be acquired simply by close observation in day-to-day experience. In fact, no source of practical information should be overlooked.

What Weight of Rail?

HOW HEAVY a rail section is a road warranted in using? This is a question which has always confronted the railway officer responsible for the maintenance of track. For years he contended that the track was failing to keep pace with the loads placed on it and that as a result the factor of safety was being reduced to the vanishing point, if it had not already reached it. For this reason he based his recommendation for heavier sections primarily on the necessity for insuring safety of travel.

Largely as a result of the recognition of the merit of his contention in this respect railway managements have made large expenditures during the last four or five years for heavier rails, as is evidenced by the fact that the production of rails weighing 100 lb. per yd. or more represented 75.9 per cent of the total in 1929, as compared with only 39 per cent in 1921. In this period of less than 10 years, the weight of rails used in main-line tracks has increased more rapidly than in any previous similar period in history.

Because of this fact safety of operation is no longer the primary consideration in determining the weight of rail. Instead, the problem is now to select that section which is most economical, all factors considered. This opens up a new line of investigation in which relatively little work has yet been done.

The most important study that has been made to date is one completed recently by the Kansas City Southern to ascertain what weight of rail it was warranted in installing in its main line. Rail of 85-lb. section has been standard on this road since 1905, and when it was decided that a heavier section was necessary the road set out to determine by scientific investigation what section would be most economical. Accordingly, tonnages of 100-lb., 115-lb. and 127-lb. sections were installed and in the light of information secured therefrom the merits of the A. R. A. 150-lb. section were also analyzed. In this study the physical properties of these various rail sections were compared and from these data the stresses developed under various loadings found on that road were ascertained. Such factors as the life of rail of the various weights under existing traffic, the influence of the section on the cost of track maintenance and on the relative wear and tear on equipment were analyzed. Indicative of the thoroughness of these tests was the fact that test trains were run over rail of various weights under different weather conditions to determine the relative train resistance thereon.

Each of these various influences was weighted and the ultimate result translated in terms of dollars saved per mile of track per million gross ton miles, as compared with the standard 85-lb. rail. The result of all this study showed that under present conditions of roadway maintenance and of traffic a rail weighing 137 lb. per yd. would be most economical.

Such a result is startling, for while the Kansas City Southern is a road of heavy trains, it is one of moderate traffic density. Yet this study shows that the

most economical rail section for it is one that is heavier than is used by any railway in the country. If such a section can be justified on this road, it is evident that in spite of the progress that has been made in strengthening track in the last few years, the railways of the country as a whole can afford to spend still greater sums to strengthen their track still more, and that only as this is done will track maintenance be put on the most economical basis.

A Year of Liberal Expenditures

DURING the last few years there has been an increasing tendency among those selling maintenance of way and particularly track materials to the railways, to compare the volume of the orders which they are booking at this season with corresponding figures for the previous year, usually to the detriment of the current year's totals, and to draw the conclusion therefrom that "business is poor." In this comparison they have usually overlooked the fact that in many of their requirements, particularly those involving rails and rail fastenings and their installation, the railways have been setting their purchases ahead several months, with the result that many orders for a year's improvement program are now placed in the closing months of the preceding year, or in the very early months of the current year. If those salesmen who have been prone to comment adversely on business conditions at this period of the year will check the records of their companies, many of them will find that a large part of the orders which they were formerly accustomed to receive at this season have been on their books for several months, if they have not already been filled.

This year another factor is accentuating this situation. It is the feeling that pervades many circles that current railway purchases are less than normal. This state of mind is giving rise to many weird rumors, ranging all the way from reports of the temporary postponement of the purchase of a small tool to the statement that a large road, name mentioned, has not bought a single dollar's worth of material for three months! In the face of reports such as this it is well to check up the facts.

Railway expenditures fall into two general classes, so far as engineering and maintenance of way activities are concerned—namely, those chargeable to capital account and those chargeable to operation, respectively. As to the first group, which embraces the outlay for extensions, additions and improvements to the properties, the Bureau of Railway Economics has just made public the results of a survey which shows that the Class I railways of the United States alone spent $134,702,000 for roadway purposes during the first three months of this year, the latest period for which such figures are available, or $45,225,000 *more* than they spent in the same period last year, which latter year was itself an active one. In the second group, which covers expenditures for the current upkeep and repair of the properties, the statistics of the Interstate Commerce Commission show that the roads spent $169,707,086 in the first three months of this year, or $10,477,018 less than in the unusually active period of a year ago. Combining the two to ascertain the full measure of engineering activity, the roads expended $304,409,000 in the first quarter of this year, as compared with $269,632,000 in the same three months of last year. In other words, instead of curtailing their expenditures the roads have actually spent nearly 13 per cent more for the maintenance and improvement of their roadway facilities than they spent a year ago.

Such figures do not lend support to pessimism. Rather they afford strong evidence of the contention that 1930 will be a year of liberal expenditures for roadway improvements.

A Thinking Force Pays Large Dividends

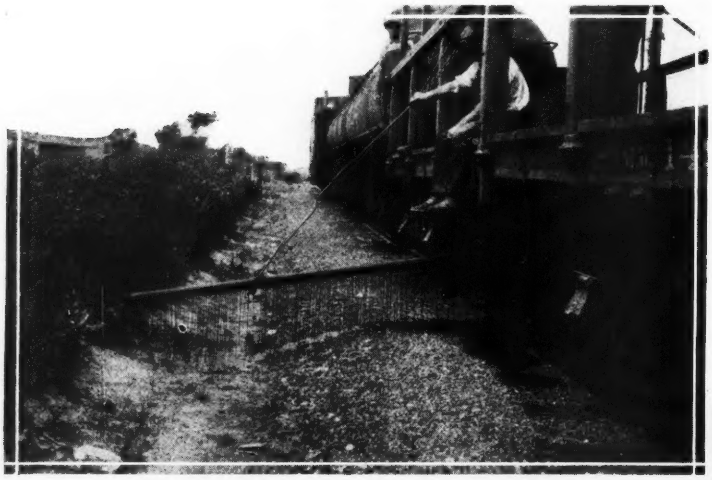
THERE ARE few better ways in which railway officers can increase their worth to their roads, enlarge the prestige of their offices and of their forces, and, incidentally, reflect credit on themselves, than to encourage constructive thinking on the part of their men. It is a simple case of capitalizing on the quite generally accepted adage that "two heads are better than one."

No one knows and few realize the full extent of the contribution of the men in the ranks toward many noteworthy ideas and methods which issue from head offices, but it is larger than is generally believed. Instances of this character are convincing. In one which recently came to our attention, a subordinate employee in an engineering department, on his own initiative, investigated a problem not directly assigned to him and made a suggestion which resulted in a saving of about $60,000. Furthermore, as a result of the suggestion, the problem was solved in a most effective manner, and the work involved was done more quickly and with less interference with train operation than would have been the case if the more elaborate and expensive plan that was about to be adopted had been carried out.

Savings such as those effected in this case are not to be considered lightly, and yet it is readily conceivable that many equally constructive ideas, born in the minds of the rank and file, never reach maturity because adequate and suitable outlets are not provided for them. Most railway officers welcome constructive suggestions on the part of their subordinates, but a cordial acceptance of ideas that are offered does not necessarily inspire constructive thinking on the part of men in the ranks. They should be invited to make suggestions and ready channels for the flow of constructive ideas should be provided. Furthermore, suitable acknowledgment should be made to those who go out of their way to offer helpful suggestions, whether these suggestions are accepted in full or not. An increasingly large number of executive and supervisory officers appreciate these facts, and it is these officers and the departments over which they have jurisdiction that are securing the most from their men.

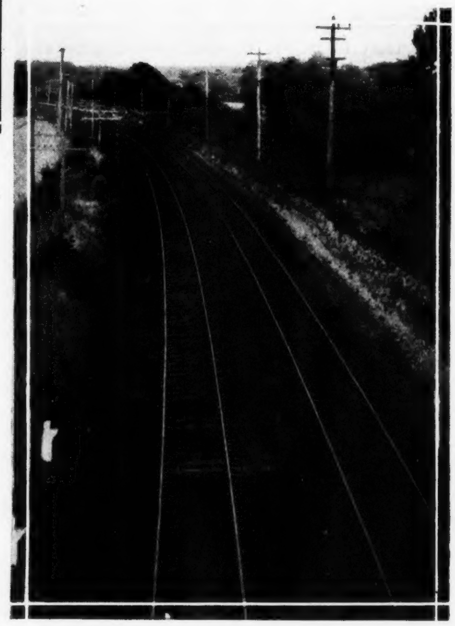
Caterpillar Tractor with Choate Bulldozer Used as a Spreader

Oiling the Roadbed Lays



One of the Wing Oilers in Operation. Note Windshield Attached

Clean operation at high speed on cinder ballast is made possible by a single application with improvised equipment



A Typical Stretch of Oiled Track in Double-Track Territory

WITH the aim of improving the service rendered to its millions of passengers, mostly commuters to and from New York City, the Long Island has continued its policy of oiling its roadbed to lay the dust raised by its high speed trains, and during the summer of 1929 it applied oil to approximately 435 miles of track, using successfully the same home-made, but efficient, equipment which it has employed in this work for the last 11 years. While the oiling of the roadbed by even the most economical means is recognized as an undesirable additional expenditure, the Long Island realizes that as long as it has cinder ballast over the major part of its lines, it will have to oil its roadbed to afford comfort to its passengers.

Adding to the necessity for this practice on the Long Island is the traffic handled by the road, which amounted to 112,546,591 passengers during the year 1928, and the high speed of its train operation. A further consideration is the fact that some of the cinder ballast is well worn and, therefore, unusually dusty unless held down by a blanket of oil. As a result of the oiling, the Long Island affords unusually clean transportation into New York City.

Oiling Confined to Cinder Ballast

Cinder ballast alone is oiled in this work, no attempt being made to oil the considerable mileage of stone ballasted track which predominates within the limits of New York City. Ever since the practice of laying the dust on its lines was started, oil has been used for the purpose, although light oils used at first were soon discarded for a heavy petroleum oil with a 65 per cent asphalt content, similar to much of the oil used in road work. The lighter oils proved unsatisfactory in that even with repeated applications, considerable dust was still stirred up, which, carrying a certain amount of oil with it, was particularly injurious to clothing. The heavier oil now used is of such consistency that it forms virtually an unbroken blanket over the roadbed, holding down the dust under even the fastest train operation.

The apparatus used in oiling the roadbed on the Long Island is an improvised affair, constructed in the road's shops, and is mounted on a standard 30-ft. flat car equipped with side posts, a railing and a canvas top. In utilizing the flat car for applying the oil, practically all of the piping was arranged under the floor and between the trucks, the only parts of the equipment above the floor including a steam line, a tool box and three oil valve operating levers. In the oiling system a 4-in. steel pipe extends throughout the length of the car on one side, directly underneath the floor, and is supplemented by two removable 4-in. flexible hose connections, with suitable couplings, of sufficient length to reach from the oil sprinkler to the outlet valves of tank cars coupled to each end of the sprinkler car.

From the 4-in. feed line the oil is fed to the oil distribution system, which is made up of three 2-in. pipes, each provided with a single line of ⅛-in. holes spaced ¾ in. center to center, and drilled on its bottom side. One of these pipes, which is 8 ft. long, is located centrally under the car, at right angles to the track, and about 3 in. above the tops of the rails.

Dust on the Long Island

At right: Cinder ballast just after being oiled. Oil eventually spreads out into a uniform blanket

Below: The three oil control levers are operated by one man

This pipe, which is fed by a 2-in. rigid pipe from the 4-in. main feed line, is permanently fixed and distributes oil to the center portion of the roadbed, within the limit of the ties, except directly on the rails and track fastenings. Oil is kept from the rails by the fact that no holes are provided in the distribution pipe over them, and further, by the provision of a shield mounted horizontally over each rail to prevent the streams of oil from the pipe being blown onto the rail by the wind. These shields, which are of pressed metal and about one foot square, are fastened to the bottom of the distribution pipe frame, and protect the rails on both sides.

The other two pipes of the sprinkler distribution system are also about 8 ft. long, and are hung out horizontally on opposite sides of the car at the center where they extend over the shoulders of the roadbed. These pipes, which normally lie in a horizontal plane about 12 to 18 in. above the top of the roadbed, have a universal joint connection to the special pipe frames on the car and are supported at their outer ends by means of chain and steel rod guys which hold the pipes in a horizontal position. These wing pipes are fed from the main 4-in. feed line through short lengths of 2-in. armored hose. By this arrangement the wing distribution pipes can be operated through a complete half circle and thereby moved in or out to prevent striking structures or obstacles along the right-of-way. They can also be raised if necessary. Sheet metal shields, rectangular in shape, are hung on the wing pipes near the car in windy weather to keep the oil from blowing on the rails.

Oil Is Readily Controlled and Applied

Originally the operation of the wing pipes was by means of two lever stands above the car floor, one on each side of the car for each pipe. These accomplished their purpose effectively, but they have not been used in recent years since it was found more effective and comfortable for the men operating the wings to sit on the car floor with their feet over the sides, where they can move the pipes outward or backward by pushing or pulling on the guys which support the outer ends of the pipes. In this position also, the operators are able to move the wing pipes with greater accuracy in passing around objects, and find it easier to raise the wings when necessary, especially when lifting the pipes up on their carriage hooks on the sides of the car when oiling is discontinued for any reason, or when the car is to make a through movement out of service.

Control of the oil to the distribution pipes is effected by means of three lever stands grouped together in the center of the car where they can be operated readily by one man. These levers, one of which controls the flow of oil to each of the distribution pipes, merely operate lift valves in the oil lines beneath the car.

Oil is delivered hot to the roadbed under the force of gravity alone, and falls from the small orifices in the distribution pipes in thread-like streams. When it first reaches the surface of the ballast or the material of a road crossing, it lays out in fine strings, but within a few hours, depending upon the temperature

of the oil and the atmosphere, the oil spreads out to form a uniform coating over the ballast.

Heating of the oil is accomplished by means of steam from the locomotive of the oil train, which passes through the coils provided in the tank cars in which the oil is received. Depending somewhat upon the weather, the oil in the cars can be made viscous enough for oiling operations by the application of steam for from two to six hours. Ordinarily, it is the practice on the Long Island to hook up the steam connection to the tank cars in the oil train as soon as the locomotive arrives, applying the steam at a pressure of about 40 lb. Following this practice, the oil is usually hot enough to begin operations as soon as the equipment gets out to the point where oiling is to begin, and relatively little difficulty is encountered with the clogging of the holes in the distribution pipes. When applying the oil continually, no trouble is experienced in this regard, the tendency to clog occurring only when spot oiling is being done, in which case the oil in the distribution pipes often becomes too cold to flow readily.

When any tendency to clog is noticed, or when there is any difficulty in starting the flow of oil from the pipes, steam under pressure is admitted into the distribution system and immediately sets up the flow of oil. Steam is also used to blow out the distribution system when oiling operations are concluded for the day. The removal of any solid or unusually thick matter, which may get into the distribution pipes and cannot be removed by the steam, is effected by means of scraper rods which can be inserted in the sprinkler pipes after removing the threaded caps provided at the ends of the pipes.

One Oiling Is Sufficient

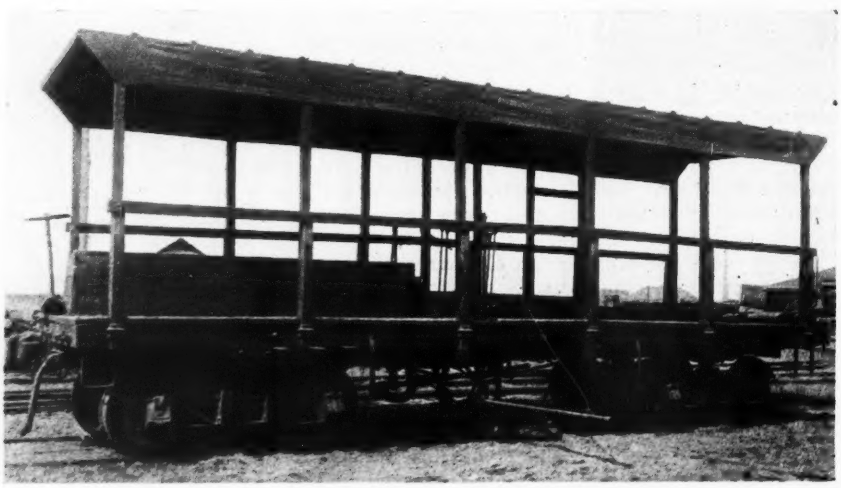
During the early years of track oiling on the Long Island, and particularly when the lighter oils were used, it was necessary to go over the tracks at least twice a year in order to make the oiling effective, once early in the spring in advance of the spring maintenance work, and again late in the spring when the major track operations necessitating the disturbing of the ballast were out of the way. For the last 10 or 12 years, however, by reason of the oiling of previous years and the use of heavier oil, one major oiling operation has been found sufficient to hold down the dust satisfactorily. This oiling is usually done between the middle of May and the latter part of June, covering the various territories out-of-face as fast as tie renewals and other major track work are completed for the year. Subsequent oiling is done only at certain dusty road crossings and at points where it has been necessary to disturb the ballast in conducting track work after the initial oiling.

Oiling the Inter-Track Space

In carrying out the work, the oiling car is run in a special work train and is operated by a force of three laborers and a foreman. Two of the laborers operate the wing sprinklers and the third operates the oil valves at the direction of the foreman, who is in direct charge and who indicates the places to be oiled. Supervisors or their assistants accompany the oil car to supervise the oiling work.

From two to five oil tank cars are usually carried in the oil train, depending upon the amount of oiling to be done during the day and, when oiling, the train is operated at speeds ranging from 4 to 12 miles an hour, depending upon the condition of the roadbed and the amount of oil necessary to hold down the dust. In all of the work, the train is operated under train orders and clears the main tracks for passenger and freight trains. Experience has shown that the most effective oiling work can be done during dry weather, and also that much of the value of oiling is lost if the oil is applied during a heavy rain. Careful observations indicate that the oiling does not tend to foul the ballast or cause pumping joints, and while it has little effect upon weeds and other vegetation in the track, any effect in this respect is to retard its growth.

During the season of 1929 approximately 435 miles of track was oiled in making single or double applications, and the average application was at the rate of about 680 gal. of oil per mile of track, equivalent to about one gallon for each 7 2/3 ft. of track. Including the cost of oil, which was 3.85 cents a gallon, and the cost of applying it, the total cost per mile of track oiled amounted to about $35.49.



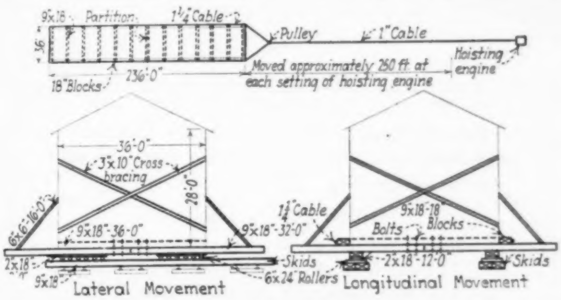
The Oiling Car Is an Improvised Affair, but Operates Efficiently

Move 5,000-Ton Ice House a Mile Intact

BY EMPLOYING novel and interesting methods, the Northern Pacific recently succeeded in moving bodily a 5,000-ton ice house, 36 ft. wide and 236 ft. long, a distance of more than a mile, including the crossing of four side and two main line tracks. The house is situated in the yard at Laurel, Mont., and the necessity for its relocation was brought about by a rearrangement of the yard facilities at that point.

The yard at Laurel lies in a general easterly and westerly direction and it was desired to move the ice house from its location north of the yard to a point south of the yard and approximately 5,000 ft. east of the original location. Since the building was parallel with the yard in both the original and final locations, it was necessary to change its direction only slightly at any time during the movement. The plans for relocating the building, therefore, called for a lateral movement of 200 ft. to the south and across the tracks; thence east longitudinally and at a slight angle with the yard for a distance of approximately 2,500 ft.; thence in about the same direction, but parallel with the yard approximately 2,500 ft., and finally, laterally to the north 115 ft. to the final location.

A View of the House When It Was Being Moved Laterally Across the Tracks



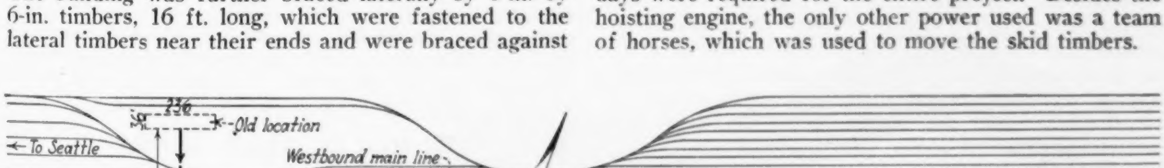
Two Sectional Views of the House and a Plan Showing the Cable Connection

After all ice and other material had been removed, the house was reinforced internally by eight sets of diagonal cross-braces, each set consisting of two 3-in. by 10-in. timbers. The structure was then elevated sufficiently to insert on the under side and at right angles to the house 13 sets of 9-in. by 18-in. bridge stringers, each set consisting of two 32-ft. timbers placed end to end and spliced on the upper side by another 9-in. by 18-in. stringer, 36 ft. long, to which the two were securely bolted. Thus, these timbers protruded a distance of 14 ft. on each side of the building. The building was further braced laterally by 6-in. by 6-in. timbers, 16 ft. long, which were fastened to the lateral timbers near their ends and were braced against the external sides of the building at an angle of 55 deg.

For the first movement of the building, 13 lines of skids were provided, each consisting of two 9-in. by 18-in. timbers placed side by side and inserted under one set of the lateral timbers. The building moved on the skids by means of rollers of wood and metal, 6 in. in diameter and 24 in. long, and two timbers, 2 in. by 18 in. by 12 ft. in dimensions, were provided as bearing plates between the under side of each lateral timber and the rollers. In this case, power was furnished by 13 screw jacks applied against the timbers under the house.

The method of moving the building in a longitudinal direction was essentially similar to that just described for moving it laterally, except that two longitudinal lines of 9-in. by 18-in. timbers were fastened to the under sides of the lateral timbers to provide the necessary bearing for the rollers for the longitudinal movement. In this case also, the 2-in. by 18-in. by 12-ft. timbers were provided as bearing plates between the rollers and the under sides of the longitudinal timbers. The power used was a 20-hp. hoisting engine, which operated a cable, 1,200 ft. long, reeved into blocks and making a six-line tackle. This cable was attached to a 1¼-in. cable which surrounded the building entirely and which was separated from it by wood blocks, 9 in. high and 18 in. square. One of these blocks was placed on each lateral timber at the point where it projected from beneath the building. After the structure had been moved about 5,000 ft. in a longitudinal direction, it was again moved laterally 115 ft. to its final location and lowered to its foundation.

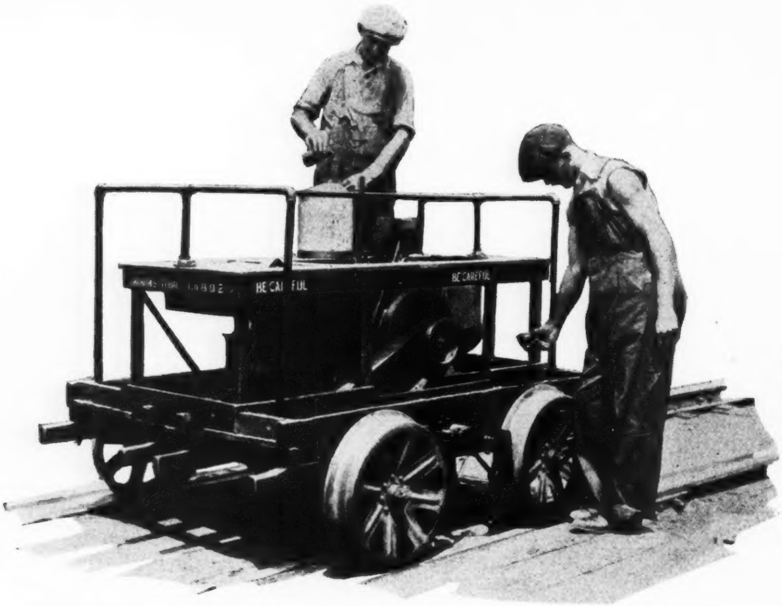
The maximum distance that the building was moved in an eight-hour day was 470 ft. and the average distance for 16 days was 313 ft. in eight hours. Twenty bridge carpenters worked on the building 10 days to prepare it for the moving operation, and 33 working days were required for the entire project. Besides the hoisting engine, the only other power used was a team of horses, which was used to move the skid timbers.



Showing the Route Followed by the House in Its Movement to the New Site

Proper

The



Good practice in oiling a motor car—The man on the platform is adding the specified proportion of lubricant to the gasoline. The other man is oiling the axle bearings

THE proper lubrication of a motor car is a comparatively simple task; yet there is no one detail of operation that bears a more direct relation to the cost of maintenance and to the life of the car, and that is at the same time more generally neglected, than the adequate lubrication of the various bearing surfaces. Although the cost of the oil, if properly used, represents only a small portion of the expense of operating the car, its application is of the utmost importance, for lubrication is essential to satisfactory operation, and any neglect in oiling will cause excessive wear and result ultimately in trouble and expense.

A properly oiled motor car will not only start and run better but will produce more power on less fuel than one poorly oiled. Proper lubrication will also prolong the periods between trips to the repair shop and very materially increase the useful life of a car. If the facts could be ascertained, we would find without a doubt that the principal cause of the premature scrapping of motor cars is poor lubrication. Above all, the oiling of various parts of the car should be done regularly as required. A few drops applied at the right time are more effective than a quart after the parts have become damaged through excessive friction and wear.

Other articles in this series on the Operation and Maintenance of Track Motor Cars will appear in succeeding issues as follows:

Group B—Operation

6—Motor car ignition.
7—The efficient operation of motor cars.
8—The safe operation of motor cars.

Group C—Maintenance

9—Field maintenance.
10—Shop maintenance.
11—Organization for maintenance.
12—Cost of operation and economy of motor cars.

Quality of Oil Is Important

Second only to regularity in the lubrication of a motor car is the quality of the oil used. It is just as important that the proper oil be used in a railway motor car as an automobile. The determination of the character of the oil to be used is not primarily a question of price but rather the selection of an oil that will be suitable for the particular car. For example, an oil may be ideal for one type of engine and yet be too light or too heavy for another type. The same variation exists to a large degree between summer and winter operation, lighter oils being used as a rule during the winter months. Where possible, it is desirable to use one oil only in order to avoid confusion in changing from one grade to another.

The best method of selecting the most satisfactory oil is by service tests. Specifications for lubricating oil are of little value unless they are supported by actual tests of the oil. This is particularly true of oils used in internal combustion engines. The principal value of laboratory analyses is to provide a means of duplicating the oil after its suitability has been determined by test. The grades of oils selected by motor car manufacturers for use in their cars are invariably determined by tests rather than by specifications.

Oil Must Be Properly Applied

It is axiomatic that constant lubrication is necessary where one part moves in contact with another, and that if friction and wear are to be eliminated the oil must be distributed over the entire bearing surface. Proper lubrication, therefore, demands not only that the proper oil be furnished at the proper time but that it be applied at the proper point, which may vary from every 10 to 20 miles for bearings to perhaps 400 or 500 miles for the oil reservoir on force or splash feed systems. Each motor car operator should thoroughly un-

*This is the fifth of a series of 12 or more articles on the Care and Operation of Motor Cars, the first of which, on the Place of the Motor Car in Railway Work, appeared in the January issue, page 5, the second, on the Type of Motor Car, in the February issue, page 54, the third, on the Motor Car Engine, in the April issue, page 158, and the fourth, on How a Motor Car Is Built, in the May issue, page 214.

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Lubrication—
Life of a Motor Car

Practical suggestions regarding a commonly neglected detail of operation that exerts a marked effect on length of service*†

By C. R. KNOWLES‡

derstand when and where each part of his car should be lubricated. It may be desirable to prepare a printed schedule of instructions relative to the lubrication of cars, for posting in the motor car house.

While the proper lubrication of all parts of a car subject to friction is essential, the engine deserves special attention as it will soon become useless without an adequate amount of oil. It is also more difficult to lubricate on account of the large cylinder and other surfaces exposed to high temperatures. Motor car engines may be classified in two general groups as regards methods of lubrication: (1) The two-cycle engine in which the lubricating oil is mixed with the gasoline; (2) the four-cycle engine which uses straight gasoline as fuel, and in which the moving parts of the engine are lubricated from a supply of oil usually carried in the crank case oil reservoir, and distributed by force-feed circulation or by a splash system.

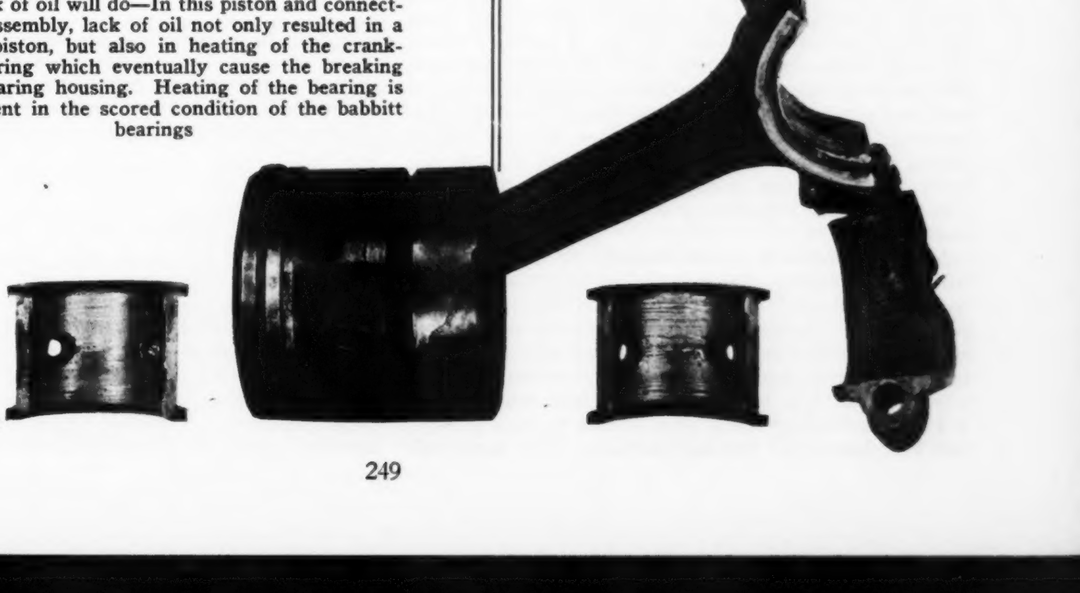
The Two-Cycle Engine

As stated above, the lubrication of two-cycle engines is accomplished by mixing the lubricating oil with the gasoline. There is considerable difference of practice among the manufacturers as to the amount of oil that they recommend for use in the fuel mixture for their various types of cars, their recommendations varying from one pint of oil to each five gallons of gasoline, up to one-half pint of oil to each gallon of gasoline. Further, conditions of operation may make it desirable to vary the amount of oil used for a given car; for example heavy loads or long runs in hot weather will naturally require more oil. The amount of oil used should not exceed one-half pint per gallon of gasoline, as an excess amount of oil merely burns in the cylinder, forming carbon deposits in the ports, on the piston, rings and cylinder, fouling spark plugs and wasting fuel. After the oil is mixed with the gasoline, lubrication is automatic with this type of engine. The crankshaft and connecting rod bearings, piston and rings are thoroughly lubricated by the oil which enters the crank case with the gasoline from the carburetor. If the proper amount of oil is used in the fuel mixture, the engine should always get the correct amount of oil, as the oil is supplied in exact proportion to the amount of fuel, and as the amount of fuel supplied determines the amount of power developed, it follows that the quantity of oil varies as the power increases or decreases. It is important that the oil and gasoline be thoroughly mixed as, unless well mixed, the heavier lubricating oil will settle to the bottom and either clog up the fuel lines or pass into the crank case in slugs, causing difficulty in starting or possible damage to the engine through improper lubrication.

Methods of Mixing

The oil and gasoline may be mixed in various ways, as, for example, by pouring the mixture from one can to another or by partially filling the can with gasoline after the lubricating oil has been added and then shaking the can violently before adding the remainder of the gasoline. One road recommends that about one-fourth the quantity of fuel needed should be placed in a measure, to which the entire amount of oil required should be added. This should then be thoroughly agi-

What lack of oil will do—In this piston and connecting-rod assembly, lack of oil not only resulted in a cracked piston, but also in heating of the crankshaft bearing which eventually cause the breaking of the bearing housing. Heating of the bearing is also evident in the scored condition of the babbitt bearings



tated with a metal spoon-shaped wire egg beater or similar device, metal being recommended instead of wood to avoid splinters or fragments of wood being left in the fuel. After this portion has been thoroughly mixed, the remainder of the fuel should be added and the whole again stirred vigorously.

Heavy lubricating oil is difficult to handle in extremely cold weather and it may be advisable to keep on hand a supply of lubricating oil that has been thinned with gasoline so that it will pour easily and mix readily with the gasoline under severe weather conditions. The fuel mixture should always be strained through a fine mesh screen when the fuel tank is filled, to remove any dirt or water. After the gasoline and oil have been properly mixed they will not separate.

The Four-Cycle Engine

Four-cycle engines are commonly lubricated by means of a force-feed oiling system, which consists essentially of an oil reservoir, usually located at the bottom of the crank case, from which the oil is forced to the principal bearings of the engine by an oil pump. The pressure of the oil is maintained by the tension of a spring in a small relief valve. Oil delivered by the pump in excess of the requirements is returned to the oil reservoir through the relief valve.

Another method of oiling four-cycle engines is known as the splash system, where the oil is contained in the crank case and the cylinder connecting rod and crankshaft bearings are lubricated by the splashing of the oil about the crank case. All of the oiling systems are effective, provided they are given the proper attention, the selection of any particular system being dependent upon the type and kind of engine used.

The oil reservoir, which usually has a capacity of about one gallon, should be filled with lubricating oil of the proper quality. The oil should be strained through a funnel having a 20-mesh wire screen to prevent dirt from entering the reservoir, the reservoir having an oil gage to indicate the high and low levels. Care should be observed in filling the reservoir to insure that the proper amount of oil is supplied. This is particularly true in extremely cold weather when the oil will not flow freely and may cling to the funnel and walls of the reservoir, giving a false gage reading. The oil gage should be checked each morning before the car is taken out and after every 25-mile run. Where small pet cocks are used as oil gages, it is well to run a wire through them occasionally to make sure that they are not clogged up.

When to Renew Oil

There is no set rule as to the frequency of renewing the oil in the reservoir, as it differs with the condition of the engine and the quality of the oil used. Ordinarily it should be renewed after about 500 miles and more frequently if necessary. At these intervals the reservoir and screen should be thoroughly cleaned and the reservoir filled with new oil. None of the old oil should be used again. If kerosene is used to wash the sediment out of the reservoir, one should make sure that none of it remains, as it will dilute the oil and cause trouble.

Where a pressure system is used, the engine should be run slowly after changing the oil until the fresh oil has been delivered to all bearings, as there is danger of scoring or burning the bearings even with a full reservoir of oil unless the oil circulates freely. This is particularly true during cold weather and with a heavy grade of oil. It is generally preferable to use a lighter grade of oil during the winter months to insure that it will circulate to all bearing surfaces. The same rule applies to engines using the splash system of lubrication as the oil must not be so stiff as to prevent the connecting rod from throwing it to all parts of the engine.

It is a good rule to use only that oil specified by the manufacturer, as his recommendations are based upon exhaustive tests with his particular design of engine. An oil that would be satisfactory for slow speed water-cooled gasoline engines, such as are used in pumping plants, or for use in locomotives or stationary steam engines, is not suitable at all for motor-car engines and should not be used under any circumstances. With the high temperatures developed in high speed motor-car engines, particularly air-cooled engines, the use of any lubricating oil other than that specified, or of equal quality, will invariably result in overheating, the formation of carbon deposits on the piston and cylinder,

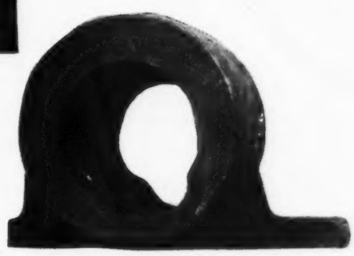
the sticking of piston rings and the scoring of the cylinder. It will also cause the engine to run hard and to lose power and compression. Results from the use of poor oil may not be apparent immediately but they will eventually cause serious damage.

Axle Bearings

Both oil and grease are used to lubricate plain, roller and sleeve-type axle bearings. Some manufacturers recommend the use of oil rather than grease on sleeve-type bearings while others provide a grease cup or Alemite connection by removing the drain plug at the bottom of the housing. As a rule, oil will give general satisfaction with all types of cars and probably requires less frequent attention than a grease cup, which should be screwed down every 10 to 20 miles on plain and roller bearings. A grease cup is preferable to oil on the loose wheel as this is a plain bushed bearing usually

provided with oil grooves but without oil space. This grease cup requires frequent attention and should be turned down once or twice a week at least.

A grease cup differs from the ordinary oil cup in that it is designed to use hard oil or grease instead of fluid oil. It is built in two types. In one, a spring above a flat plunger completely fills the cup, the tension of the spring maintaining a constant pressure on the grease and automatically forcing it out of the cup as required. In other words, the cap of the cup is threaded to fit the shank and the oil is forced out by screwing down the cap. Nearly all grease cups used on motor cars are of the latter type. Grease cups are generally provided with ratchet tops to prevent them from coming loose under vibration. The advantage in the use of cup grease instead of oil is that it will not



What happens to axles that are not lubricated and kept free of dirt and grit. Axle bearings also suffer from improper care, as shown in the two lower views

flow and a turn of the cup will provide lubrication where oil could not be retained.

The proper lubrication of axles is of special importance from the standpoints of both safety and maintenance as excessive axle wear on both plain and roller bearings is due either to insufficient oil or to dirt and grit in the bearing. The faces of thrust collars should be oiled regularly where they do not get sufficient oil from the bearing, to avoid undue wear.

Magneto and Timer

It is important that the magneto receive sufficient lubrication, and of equal importance that it does not receive too much. Magnetos are provided with small hinged lid oil cups requiring from one to four drops of light oil at intervals of from 20 to 200 hours operation. Instructions as to proper oiling always accompany each magneto installation and should be followed closely as a great deal of magneto trouble is due to the careless use of oil.

As with the magneto, care should be followed in oiling timers. Roller contact timers should be kept well oiled with a good clean soft grease, either cup grease of the right consistency or vaseline. The timer should be cleaned occasionally by washing out the grease and dirt with kerosene. The timer ring or casing should be oiled with a drop or two of good lubricating oil where it revolves on the shaft or hub of the flywheel.

Counter-shafts

Motor cars with friction and two-speed drive have counter-shafts, usually provided with grease cups. The proper lubrication of these counter-shafts and the square spline shaft of friction drives is of equal importance with the oiling of other parts, and they should be kept clean and oiled regularly.

All other bearings should be well oiled at all times and oil and grease cups kept filled with the proper grade of oil or grease. All oil and grease cups should be cleaned at regular intervals. This is particularly true of grease cups as the best of greases become hardened in time and clog the oil feed to the bearing. The frequency with which the grease cups should be screwed down depends upon the speed of the bearing and the load. For example, grease cups on the main bearings of engines should be screwed down at intervals of about five miles while every twenty miles is sufficient on axle bearings. Keep oil and grease cups and bearings free from dirt and cinders. Where the grease cup is hard to turn, it is not safe to assume that the cup has taken a bearing on the grease for it is possible that the cup is cross threaded and that as a result the bearing is not being properly lubricated. Emphasis should be placed upon keeping all bearings tight, clean and well oiled as this will insure a smooth running car and long service for the bearings. Failure to observe these precautions will shorten the life of the car.

Oiling bearings by hand is wasteful, as more oil is usually applied to the outside of the bearing than to the inside. There is also a greater possibility of neglect as more frequent oiling is necessary with hand oiling. To avoid this waste, and at the same time reduce the possibility of neglect, oil or grease cups should be applied to all bearings where possible.

Chains and gears should be lubricated with either gear compound or with the same oil that is used in the engine, mixed with a little graphite. An excessive amount should not be used as it will be thrown off. Transmission and other enclosed gears should be lubricated with gear compound or transmission grease.

The Use and Waste of Oil

Lubricating oils and greases for motor cars are usually handled through the supply department and distributed to outlying points by passenger train or direct from the supply car where supply trains are operated. The oil is furnished for the individual car in two to five-gallon cans, depending upon the amount used and the frequency with which deliveries are made. The grease is supplied either from bulk or in one-pound cans. The latter is preferable as it is more convenient, lessens waste and enables the grease to be kept cleaner than when handled in bulk.

It is difficult to fix the quantity of oil to be used by motor cars owing to the differing conditions under which they are operated. For example, the consumption of oil by section cars is affected by the grades, the number of men in the gang, the length of section and the location of the headquarters. The average section

car of the single-cylinder type, operated 20 miles per day, will use approximately 1 gal. of oil and about 2 lb. of grease per month or approximately 3 pints of oil and ¼ lb. of grease per 100 miles.

Oil is often wasted when emptying barrels or containers, through carelessness in leaving a quantity in the container. Several gallons of oil may be left in a barrel if the proper care is not exercised in emptying it. This is particularly true of the heavier oils handled in cold weather when the oil does not flow freely.

Oil is also wasted in filling cans and oil cups by overflowing. This can be overcome by the use of funnels and the proper type of oil can. Careless handling of oil cans by placing them where they may be overturned or damaged is wasteful. Keeping an excessive amount of oil on hand causes waste, not only through the deterioration of the oil and possible damage through the accumulation of dirt, but it also invites waste through damage to the container and frequently the use of an expensive oil instead of a cheaper oil.

Keep Lubricants Clean

Never put oil in a dirty can or use the same can for more than one kind of oil, for to do so invites lubrication troubles. Cup grease should be kept in covered cans. It is not at all unusual to find it wrapped in a piece of dirty paper where it is subject to the accumulation of cinders and dirt, not to mention the waste of the grease itself.

One gallon of oil contains approximately 29,000 drops. Six or eight drops are often used in the lubrication of motor car bearings when two or three are ample. This in itself is not a serious waste, but if we make the comparison with six or eight barrels of oil where only two or three are needed, the waste, in the aggregate, can be better appreciated. It is, of course, essential that sufficient oil be used for the proper lubrication of motor cars and it is better to use too much than not enough, but reasonable economy should be practiced in its use, as the only purpose that an excessive amount of oil can serve is to create and collect dirt and cause additional work in keeping the car clean. A car with its frame or working parts covered with a coat of grime is a potential hazard as dirt and grease are obstacles to proper inspection.

Rules for Lubricating Motor Cars

The following rules have been drafted as representing good practice in motor-car lubrication:

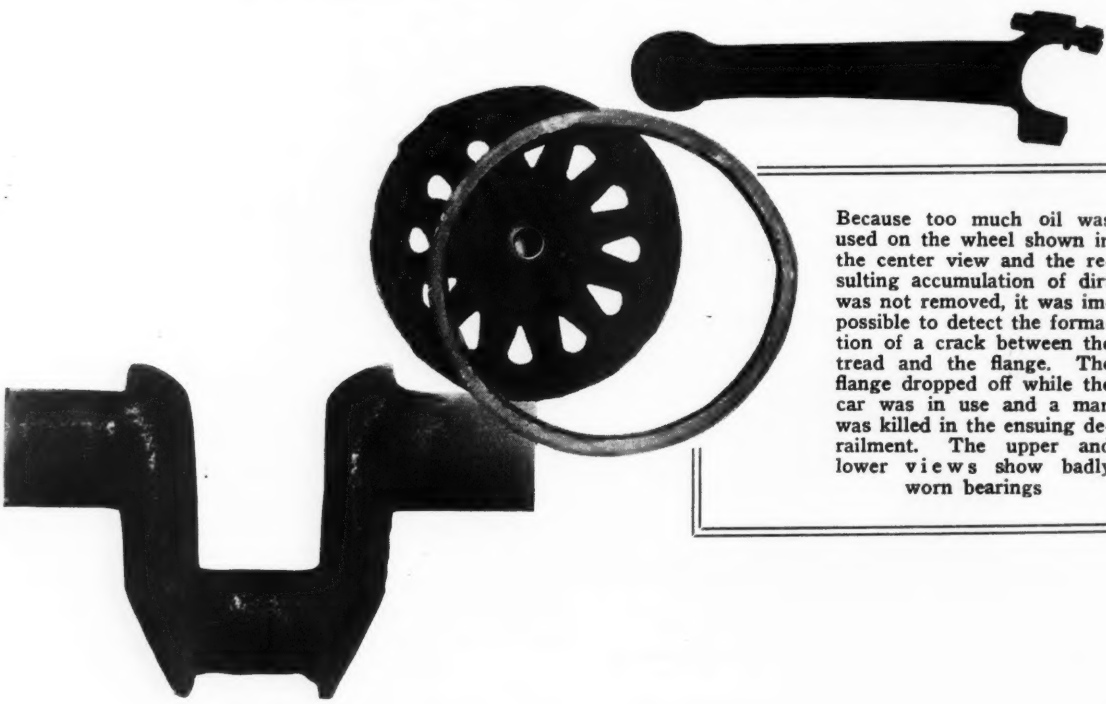
(1) The first rule of motor-car operation is the proper lubrication of all bearing surfaces; if carried out regularly, it will avoid trouble and expense, improve the operation of the car and prolong its useful life.

(2) Use a good grade of oil at all times. In the selection of oil, follow the recommendations of the manufacturer or determine the quality of oil to be used, by careful tests.

(3) Where the lubricating oil is mixed with the fuel, use the exact proportions of oil and gasoline, as determined by actual measurement, and mix them thoroughly before pouring into the fuel tank.

(4) Maintain the proper oil levels in the oil reservoirs of engines, using pressure or splash systems, renewing the oil at specified times, usually after about 500 miles. The oil should always be strained through a wire mesh screen.

(5) Particular care should be given to the lubrication of axle bearings. Where oil is used, these bearings should be oiled about every 50 miles; where grease cups are used, the grease cup should be turned down every 20 miles.



Because too much oil was used on the wheel shown in the center view and the resulting accumulation of dirt was not removed, it was impossible to detect the formation of a crack between the tread and the flange. The flange dropped off while the car was in use and a man was killed in the ensuing derailment. The upper and lower views show badly worn bearings

(6) Oil magnetos carefully as too much oil will interfere with their operation. Use from one to three drops in each oil hole every one hundred hours of operation and do not permit surplus oil to reach any other part of the magneto.

(7) Keep the timer ball or button oiled with clean soft grease, applying oil to other parts of the timer as required. Remove all surplus oil or dirt.

(8) All other bearings should be oiled frequently and regularly, the frequency depending upon the work they are required to do. A good rule is to inspect the oiling system daily, making sure that oil is reaching all bearings.

(9) Keep oil cups, grease cups and oil holes clean, washing them out occasionally with gasoline or kerosene and using a wire or small brush to remove any caked oil or dirt.

(10) Do not use more oil than is necessary. Overflowing oil cups or oil holes serve to collect dirt. Wipe off any surplus oil to insure keeping the car clean.

When the New Line Is Completed the Maintenance Officer's Problems Begin

A Square Deal for the Maintenance Man*

Practices followed by the construction forces that have an important influence on the difficulties of upkeep after new tracks are placed in service

By WALTER S. LACHER† and GEORGE E. BOYD‡

IN THE presentations made by the railways in connection with federal valuation, frequent use was made of the term "seasoned roadbed," it being their contention that a railway which had been in use for a considerable time has elements of value not possessed by a new line built to the same standard and involving the same grading quantities. There is nothing theoretical about this. The greater value of a "seasoned" property represents the result of the excess in the outlay for maintenance, over what might be termed normal maintenance expenditures, which it is necessary to put into the property during the early years of its use.

Ideal Conditions Do Not Exist

If all railroad embankments could be built on ground that would not settle and were made of material that did not shrink, and if all cuts were excavated through earth that would not wash or slide, and roadbeds would not absorb water and get soft, then a new line would be just as good as an old one and the maintenance of a new line would entail no particular problem. But such ideal conditions do not exist. The construction department must build the new line or the second track, the revised line or the new yard where considerations of traffic, grade, alinement and economies of construction demand that it be located, regardless of the material encountered. Thus, in Canada, hundreds of miles of lines have been built across muskeg swamps in spite of the fact that they were bound to be subject to settlement, simply because there was no other place to build them. Mountain lines, for the same reason are built against side slopes where there are possibilities of sliding rock strata. But these are special conditions requiring special treatment that need not be discussed here. What we are concerned with are the more common conditions encountered in ordinary railway construction, the objectionable conditions that are imposed when a new line involving no particular difficulties in construction is turned over to the operating department.

There are those who believe that many engineers in charge of the construction of a new line have had an insufficient amount of maintenance experience, so that they have no adequate conception of the trials which they are leaving as a heritage for their successors, the roadmaster and division engineer, who must maintain the track during the process of seasoning as well as for all time thereafter. This is not intended to be a criticism of the construction engineers of the railways as a whole, because, in the main, they have done a splendid job, as is attested by the many thou-

* Presented before the Maintenance of Way Club of Chicago
† Managing Editor, *Railway Engineering and Maintenance*.
‡ Associate Editor, *Railway Engineering and Maintenance*.

sands of miles of stable track substructure in every section of the country. It is desired merely to call attention to a few instances where lack of maintenance experience has led to errors of omission or of commission which later increased the difficulties of maintenance.

In excavating cuts there is, of course, no choice; the material as produced by nature must be removed and if loose or faulted rock overlies a bed of water-bearing clay, it is usually necessary to face the conditions as they are found. However, if this condition is discovered in time, as a result of borings, it may be possible to avoid it by a change in the grade line.

One of the difficult problems a construction engineer often encounters is found on sidehill work where the rock, which is overlaid with an earth cover, slopes sharply toward the valley. In such situations, it is not unusual for the overlying earth on the hillside to slide onto the track and for the fill to slide down toward the valley. This trouble has been corrected by drilling deeply into the rock, both below and above the railroad, and shooting it with heavy charges of dynamite. This, of course, is a rather delicate undertaking and is much better done during construction than afterward, as it would call for considerable courage on the part of a maintenance officer to initiate a measure which might easily result in shooting away or burying a part of the roadbed, and the tying up of traffic for several days.

There is also opportunity to exercise judgment in determining how flat the slopes of cuts should be to insure against sliding, whether extra width should be provided at the base for larger ditches, and as to the widths of berms at the dividing line between earth and rock. In a case recently observed, the maintenance forces were compelled to keep ditchers at work for months after a line was placed in operation, simply because the sides of the cuts would not stand at the slopes to which they were excavated.

Another factor that has an influence is the degree of refinement to which the sides of the cuts are dressed. This was a simple matter in the days of hand labor and team work, but with shovels equipped with large-capacity dippers it is more difficult. Some roads, however, are very exacting in the dressing of cut slopes because a smooth slope will not wash as readily as one that contains pockets which tend to concentrate the water in spots.

The scaling of deep rock cuts as the result of frost action and the seepage of water often present a serious situation. An instance is recalled where every effort was made to overcome this trouble, yet within one or two days after the scaling had been completed a large rock crashed down onto a passenger train, going completely through the roof of one of the cars.

In general, cuts are not tiled until conditions during operation show that this is necessary. Some roads, however, follow the practice of providing complete subsurface drainage as a part of the construction job. A notable instance of this is to be found in some deep cuts in the approaches to the new Cleveland Union station, which are provided with lines of perforated corrugated pipe under each ditch and also one line between the two center tracks, with catchbasins at intervals of 250 ft. to take winter drainage when the ground is frozen and the pipes cannot function.

Removing Unstable Materials

Sometimes measures to prevent trouble go even further than this. If the bottom of the cut is of especially soft material, it may be advisable to excavate several feet below roadbed level and back fill

At the left: Slides in a deep cut may be unavoidable but adequate consideration of the necessary slope to insure repose of the material is an important factor in their prevention

At the right: Smooth slopes are possible with shovel excavation and are an important factor in the prevention of erosion

with cinders, or other material suitable for an unusual depth of sub-ballast. In this connection mention may be made of the fact that the Louisville & Nashville puts a concrete floor in its tunnels, regardless of how solid the rock through which the tunnel was excavated. Experience has shown that ballasted track laid on the concrete floor can be maintained in good surface under the unfavorable conditions encountered in a tunnel for much less expenditure than track laid directly on the natural tunnel bottom.

In the construction of embankments, the builders have little or no choice as to the ground upon which fills are to be placed, but they can sometimes exercise discrimination in the choice of material to go into an embankment. However, a case may be cited where a fill was to be built on a hillside which consisted, to some depth, of a bed of fire clay which was almost sure to slide as soon as it was subjected to the weight of the embankment. To obviate this hazard, a shovel was put on this slope to excavate the fire clay to a depth of about 20 ft. for the full width of the embankment base and a length of 300 ft. before the filling was placed. At another place on this same line, foundation conditions were materially improved by providing drainage for the base of an embankment placed on soft, swampy ground. The ground surface was ribbed, that is, transverse trenches, six feet wide and four deep, crossing the site of the fill at intervals of 25 to 50 ft., were filled with loose rock before any filling material was placed, care being taken to see that these underdrains had an adequate outlet to carry away any water that accumulated in them.

Every maintenance officer is familiar with second-track or passing-track embankments and their tendency to slide on the face of the embankment for the original track. Good practice demands that the slopes of old earth fills shall be plowed or otherwise roughened before the new fill is placed against them. Failure to do this in one case not only resulted in a serious slip of the adjacent fill for a new double-track line, but also caused the rear of a U-type abutment to move four inches out of line.

Preventing Slides

A similar danger exists where a fill is placed against a steep hillside, and one of the writers recently observed measures taken to prevent trouble in such a situation. The hillside has practically a 1½ to 1 slope for the entire vertical distance of 70 ft. from the roadbed level to the bottom of the valley. As a consequence, the embankment was virtually a thin, parallel-sided slab of earth resting against this hillside, thus offering exceedingly favorable opportunities for a slide. To reduce the danger of a slide, the plane of the hillside was broken up by cutting a bench in the slope half way up; in other words, a shovel excavating from the slope and casting over the side formed an 18-ft. shelf half in cut and half in fill.

However, in the majority of cases, trouble with embankments is due to the character of material from which they are made. On a line recently completed, a fill that called for 185,000 cu. yd. of material required the placing of 350,000 cu. yd. before the roadbed could be finished to grade, because the soft, mushy material used simply spread all over the landscape. In most cases, little else can be done for no other material is available, but in some instances considerable quantities of unsuitable material taken from cuts has been wasted rather than allowed to give trouble in the fill.

But the trouble for the maintenance officer is more often with the fill that continues to slide out long after the line is placed in service. It is sometimes necessary to widen shoulders and make culvert extensions 10 to 15 years after the embankment is complete, because of the slow but progressive sliding of embankment slopes.

Team Work Fills Are Usually Thoroughly Solidified

Influence of Construction Methods

The behavior of a fill depends also on the manner of its making. Years ago, when fills were made with slips, wheelers and wagons, every part of the embankment was thoroughly compacted by the feet of the animals and the skinners and the wheels as the material was brought in and deposited. This is true also of teamwork fills today and to a certain extent of motor equipment with either wheel or caterpillar treads, although with motorized equipment advantage is taken of the opportunity for tailboard dumping to build the embankment progressively from each end at roadbed level. The embankment formed by dumping from a trestle, the most common method today, receives none of this compacting effect and dependence must be placed on the solidification due to weight and too often on the effect of traffic. This method is much cheaper than any other in the great majority of cases and will, no doubt, continue to be used in spite of the excessive settlement that necessarily follows with materials of a clayey or earthy nature. The difficulties would be reduced if embankments could be allowed to season through at least

one winter before they are put to use, as is done frequently in the case of highway construction, but this, of course, is out of the question for railway work since it is usually necessary to lay tracks for construction purposes even in advance of the time that the completion of the entire line makes it available for transportation.

The Cause of Water Pockets

Water pockets are a source of trouble years after a line is completed, but in many cases the difficulty can be ascribed to basic defects in construction, some of them preventable and others impracticable of prevention. In its simplest form, a water pocket is a depression in the surface of a roadbed formed of earth or clay, that is filled with a porous material such as is suitable for use as ballast. Such water pockets are sure to be formed if track is placed in service with an insufficient depth of ballast on a roadbed material that shrinks or subsides under load. One authority goes so far as to state that the only way to insure positively against water pockets in any material that is slow to subside is to put the track up on earth or other impervious ballast and operate it on this until the roadbed has thoroughly compacted. This, of course, is an extreme expedient and much can be done short of this to guard against the water pocket. For example, there should be an insistent demand that the roadbed be crowned, as provided in the grading specifications, and that the embankment be thoroughly finished. Too often, in the rush of getting a line opened, the roadbed is accepted in an unfinished condition and ballast is placed before time has been taken to smooth up the surface, fill up holes or otherwise put it in proper condition.

It occurs sometimes that an embankment that has been stable for years suddenly develops defects for no apparent reason. If a careful search is made, the cause will often be found in some fault of construction. There is a case in point where the resident engineer did not think it important to remove the caps and stringers of the filling trestle, which had been constructed of hewed logs cut on the right of way. About 10 or 12 years after the line was put into operation the decay of this timber permitted the formation of water pockets and caused some bad slides.

An Aggravated Case

An aggravated case of sliding resulted from the inexperience of a resident engineer who disregarded these fundamental considerations and thought to save the cost of a filling trestle. There was insufficient material from the side borrow to complete the fill, which was 1½ miles long and ranged from 15 to 30 ft. high. The remainder of the material above that available from side borrow was to be made by means of train fill and he instructed the contractor who constructed the base, to place the borrowed material in the form of a narrow ridge about eight feet below grade. This base, which lacked many feet of reaching out to the slope stakes, was firmly compacted by the teams and wheeled scrapers, while the remainder of the material was loose and of an entirely different character. The gravel ballast was applied immediately and the line put into operation at once. The ballast settled into the unseasoned subgrade which developed a number of soft spots. During the spring rains, the water seeped down to the compacted core and followed the surface of this more impervious material, saturating the base of the outer layers of loose earth, creating slides which gave trouble for years and cost many times what a filling trestle would have cost.

Not long ago one of the writers went over a grade revision job upon which the track was being raised from 4 to 10 ft. The raise to final grade was made on bank-run gravel, this part of the fill being made as narrow as practical in view of the necessity of maintaining operation during the progress of the work. The fill was then widened by means of side borrow, brought in with wheeled scrapers. It is certain that the maintenance officers on that division are in for a serious time in the near future.

Widening Banks with Impervious Material

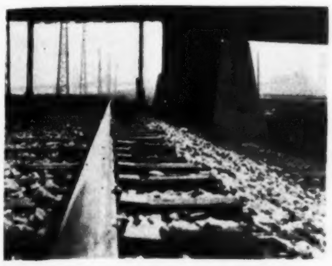
A more common practice leading to the same condition is often followed in widening the roadbed. The shoulders are extended by using material removed from the ditches or from the sides of cuts and where this is impervious material, this usually means that the dam of impervious material which keeps in the water contained in the ballast pressed down in the roadbed is made heavier and more water-tight than ever. A better method is to use a spreader blade to cut down the shoulders well below roadbed level, after which they are restored to normal level with the old ballast that is removed from the track down to the level of the bottoms of the ties preparatory to reballasting, or locomotive cinders can be used to advantage in building up the shoulder.

Much can be done by the construction forces in the way of draining borrow pits, particularly in sections where there is an infestation of muskrats. In bottom land where complete drainage is often difficult, wide berms should be left between the foot of slopes and borrow pits to prevent muskrats from reaching and burrowing into embankments. A blanket of cinders is also effective.

The decision as to the size of drainage openings is a matter of prime importance and often calls for considerable ability, coupled with experience. Reference is made to the experience of one of the writers on his first residency, when instructed to furnish a list of the waterway openings with their sizes. He was quite uneasy for fear he might make some mistakes. He discussed the matter with the engineer in charge, a man of wide experience, who replied that his method was to go over the line on foot with a profile, marking the size of the openings which he thought would be sufficient, noting those which might later require a survey of the drainage area. Then, when he returned to the office he made a list of all of the structures, in which he increased the size of every opening by 50 per cent. In justification of this practice, he remarked: "I've never had a bridge or culvert wash out because it was too small, nor have I ever been criticized for making them too big."

As a whole, the construction engineers who have located and built our railways have done a creditable job. The surprising thing, when one considers the difficulties with which they have had to contend and the widely varying conditions they have encountered, is that they have done their job as well as they have. The instances of improper practice, which have been mentioned, are the exception rather than the rule. The present tendency of the railways is toward intensive development rather than toward expansion, and the lessons that have been learned regarding the details of construction which make for better maintenance are being applied to a greater extent than formerly.

Revising Grade Lines by String-Line Methods



By PHILLIP KISSAM*
and CARL T. HOFFMAN

Two Views of the Track on Which this Method Was First Applied

THE PROBLEM of determining the proper grade to which to bring an existing railroad track with a sharply undulating profile presents a difficult proposition at best. The true vertical curves and straight grade lines which were called for in the original design have usually been departed from to such an extent as to require altogether too much expense to restore them. The problem then is to provide a smooth riding track without resorting to high raises at any points.

Just such a problem was encountered on Line No. 2 of the Pennsylvania, east of Tower "F" at Long Island City. The problem was finally solved by the development of a method which requires much the same sort of computation as that employed in string lining horizontal curves and which accomplishes the required results without the usual delay of plotting the track elevations. The method is, of course, general in its application and is suggested as a solution of the problem of selecting suitable grades for rolling profiles which have many sharp breaks.

If the existing elevations of such a track are determined, a short study soon demonstrates that it is impossible to adopt for the final profile a combination of true computed vertical curves and straight grades which fit nicely and do not require extensive computations. A grade line laid with the aid of curved templates, and the elevations found by scaling them, is much better but difficult to apply when the changes in rates of grade† are large and continuous. The method which was used has the advantages of being applicable to any type of profile and of giving theoretically correct results. It is mechanical in its application and can be computed in the field without resort to plotting the elevations of the present track in the office. From a practical standpoint, the raises called for are at the control of the engineer doing the work so that an excellent grade line may usually be obtained without extensive track work. In short, the method shares in results, speed and simplicity the advantages which accompany the string lining of horizontal curves.

The necessary computations require two short steps which are not used for horizontal curves; however, the check is shorter and more direct. To illustrate the arithmetic, the track for which this method was developed is used. In general, four steps are necessary. Note Table I.‡ Columns 1 and 2 are self-explanatory.

(Col. 3). "Rate of grade." Subtract the elevation below from the elevation above, keeping track of the algebraic sign.

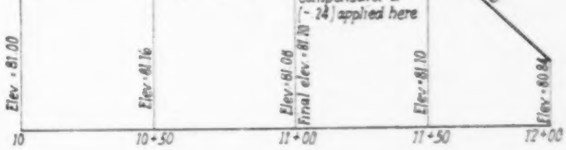
(Col. 4). "Change in rate of grade." Subtract the rate of grade below from the rate of grade above, keeping track of the algebraic sign.

(Col. 5) and (Col. 6). "Compensator" and "Final Change in Rate of Grade." These figures correspond to "throws" and "final ordinates" for horizontal curves and are obtained in much the same way. Compensators must always be negative in order to avoid running under the present profile. See Table III. with explanation.

(Col. 7). "Final raise." Divide compensators by (-2).

The Results May be Checked

It was found that a good check for the arithmetic was obtained by computing the final elevations, by adding the raises to the original elevations, and by determining the final rates of grade and final changes in rate of grade in the same manner as Columns 3 and 4 were



A Simple Illustration of How the Grade Line Is Affected by the Application of a Single Compensator

computed. Obviously, Columns 6 and 10 of Table I. should correspond. When the track was raised in accordance with the figures in this table, its riding qualities were excellent and its appearance splendid.

When laying a grade line, it is necessary to make the changes in rate of grade at succeeding points as nearly uniform as possible throughout, or, where this is impossible, to make these changes gradually increase or gradually decrease. When the succeeding rates of grade differ but slightly from each other, there are no sudden changes of motion and the track rides comfortably. Using a system which is somewhat analogous to that applied to offsets, to compute throws from string-line

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†Throughout this article, "rate of grade" refers to the difference in elevation between 50-ft. stations.

‡Because of lack of space, that part of the profile beyond Station 9 has been omitted from Tables I and III.

notes for horizontal curves, a plan is worked out which will distribute and smooth out the irregularities in the rates of grade.

In order to explain in further detail this "smoothing out" process, Table III. is given. This table shows the actual computations used for the track in question. Computations depend on the one simple principle illustrated in the figure. Here are shown stations, elevations and rates of grade for an assumed piece of track.

When the track is raised 0.12 ft. at Station 11, the result is shown by the broken line. Note the resulting alterations in the changes in rate of grade:

Station	Original	New	Alteration
10+50	—.24	—.12	+.12
11	+.10	—.14	—.24
11+50	—.28	—.16	+.12

The alterations at Stations 10+50 and 11+50 are of opposite sign and one-half the amount of the alteration at Station 11. Also the raise at Station 11 is of opposite sign and one-half the amount of the alteration at that station.

The following two rules control all the computations:

Rule 1. Wherever an alteration in the change in rate of grade is made at a given station, the changes in the rate of grade at the preceding station and at the following station are automatically changed by one-half this alteration, but in the opposite direction. Thus, in order to smooth out irregularities, an assumed figure, called a compensator, is applied wherever it seems necessary and the resulting changes in the rate of grade computed at the three stations affected, by algebraically adding the amount of the compensator to the change in rate of grade at the station where applied and algebraically subtracting one-half the amount of the compensator from the changes in the rate of grade at the preceding and following stations.

TABLE - I

1 Station	2 Elevation	3 Rate of Grade	4 Change in Rate of Grade	5 Compensator	6 Final Change in Rate of Grade	7 Final Raise	8 Final Elevation	9 Final Rate of Grade	10 Final Change in Rate of Grade
0+00	2.31					0	2.31		
		+.81						+.81	
0+50	3.12		-.03	0	-.01	0	3.12		-.01
		+.78						+.80	
1+00	3.90		-.03	-.04	-.04	.02	3.92		-.04
		+.75						+.76	
1+50	4.65		-.03	-.06	-.05	.03	4.68		-.05
		+.72						+.71	
2+00	5.37		-.08	-.04	-.05	.02	5.39		-.05
		+.64						+.66	
2+50	6.01		-.07	-.08	-.06	.04	6.05		-.06
		+.57						+.60	
3+00	6.58		-.02	-.14	-.08	.07	6.65		-.08
		+.55						+.52	
3+50	7.13		-.10	-.08	-.10	.04	7.17		-.10
		+.45						+.42	
4+00	7.58		-.13	-.02	-.11	.01	7.59		-.11
		+.32						+.31	
4+50	7.90		-.16	0	-.12	0	7.90		-.12
		+.16						+.19	
5+00	8.06		-.12	-.06	-.13	.03	8.09		-.13
		+.04						+.06	
5+50	8.10		-.02	-.10	-.09	.05	8.15		-.09
		+.02						-.03	
6+00	8.12		-.13	0	-.05	0	8.12		-.05
		-.11						-.08	
6+50	8.01		-.02	-.06	-.02	.03	8.04		-.02
		-.13						-.10	
7+00	7.88		-.01	-.12	+.01	.06	7.94		+.01
		-.14						-.09	
7+50	7.74		+.07	-.22	+.02	.11	7.85		+.02
		-.07						-.07	
8+00	7.67		+.04	-.22	+.01	.11	7.78		+.01
		-.03						-.06	
8+50	7.64		+.06	-.16	+.02	.08	7.72		+.02
		+.03						-.04	
9+00	7.67		-.07	-.02	+.01	.01	7.68		+.01

As a Check, the Values in Columns 6 and 10 of This Table Should Correspond

TABLE - II

1 Station	2 Elevation	3 Rate of Grade	4 Change in Rate of Grade	5 Compensator	6 Final Change in Rate of Grade	7 Final Raise	8 Final Elevation	9 Final Rate of Grade	10 Final Change in Rate of Grade
10+00	81.00						81.00		
		+.16						+.16	
10+50	81.16		-.24		-.12		81.16		-.12
		-.08						+.04	
11+00	81.08		+.10	-.24	-.14	+.12	81.20		-.14
		+.02						-.10	
11+50	81.10		-.28		-.16		81.10		-.16
		-.26						-.26	
12+00	80.84						81.84		

By Following the Figures in This Table, an Idea Is Gained of How the Method Works

Rule 2. In order to produce the alterations called for, a raise, equal to the compensator divided by (—2), must be made at the station where the compensator is applied, but the elevations of the two adjoining stations are not affected by the application of this single compensator.

To illustrate this point, Table II. is used as an example of how the problem would normally appear. A compensator of (—.24) is added, as an assumption, to the change in rate of grade at Station 11, giving (—.14) as a result. It is then necessary, according to Rule 1, to add (+.12) to the changes in rate of grade at Stations 10+50 and 11+50, giving (—.12) and (—.16), respectively. This calls for a raise in elevation at Station 11 of (+.12) ft., in accordance with Rule 2. Columns 8, 9 and 10 show how the check is applied by computing the final rates of grade and the changes in rate of grade from the revised elevations.

TABLE - III

1 Station	2 Change in Rate of Grade	3 Computations	4 Final Compensator	5 Final Change in Rate of Grade
0+00				
0+50	-3	-1	0	-1
1+00	-3	-2 U-4 -4	-4	-4
1+50	-3	G-2 -5 -4 -5	-6	-5
2+00	-8	-7 -4 -7 -5	-4	-5
2+50	-7	-5 -4 -5 V-4 -7 -6	-8	-6
3+00	-2	E4 -6 -4 -6 -4 -6 W-2 -8	-14	-8
3+50	-10	-8 -4 -10 -4 -12 -11 -10	-8	-10
4+00	-13	-11 -9 X-2 -11	-2	-11
4+50	-16	-14 -13 -12	0	-12
5+00	-12	-9 C-4 -13 -11 E-2 -13	-6	-13
5+50	-2	A-6 -8 -6 D-4 -10 -9	-10	-9
6+00	-13	-10 -8 -6 -5	0	-5
6+50	-2	B-4 -6 -3 0 Y-2 -2	-6	-2
7+00	-1	+1 R-6 -2 S-6 -5 0 +1	-12	+1
7+50	+7	-6 +7 -6 +7 T-10 +2	-22	+2
8+00	+4	-6 +4 -6 +4 -10 -1 +1	-22	+1
8+50	+6	-6 +3 -6 0 +5 +6 B-4 +2	-16	+2
9+00	-7	-4 -1 Z-2 -2 -1 +1	-2	+1

This Table Is an Example of How the Computations Are Carried Through for a Typical Section of Track

To demonstrate how this work is carried through for a profile problem, the actual computations for the track in question have been arranged in Table III. All numbers in this table, except stations, represent hundredths of feet. Each step has been lettered to give the order in which the work was done. The enclosed numbers are compensators and those preceded by brackets are the resulting changes in rate of grade.

The first move was made at Station 5+50 because the changes in rate of grade show a large fluctuation at that point. A compensator of (—6) was assumed, giving changes in rate of grade as follows:

Station	Change in Rate of Grade	Compensator and Corrections at Adjoining Stations	Resulting Change in Rate of Grade
5+00	—12	+3	— 9
5+50	— 2	—6	— 8
6+00	—13	+3	—10

Station 6+50 did not conform to this series of changes in rate of grade, therefore move (B) was made at that point and a compensator of (—4) was applied, thus:

Station	Change in Rate of Grade	Compensator and Corrections at Adjoining Stations	Resulting Change in Rate of Grade
6+00	now —10	+2	— 8
6+50	— 2	—4	— 6
7+00	— 1	+2	+ 1

This process was applied repeatedly, wherever dictated by necessity, until the changes in rate of grade became as uniform as practicable. The work was often facilitated by applying compensators at two or more stations at once, as move (V) at Stations 2+50, 3+00 and 3+50. The following rules for altering the changes in rate of grade in this event may be checked by applying the compensator at each station.

1. Add compensator divided by (—2) at stations previous to and immediately following series of compensators.
2. Add compensator divided by (+2) at stations at the beginning and end of a series of compensators.
3. No change at all intermediate stations.

Column 4 is the algebraic sum of the compensators and gives Column 5 in Table I. It is most convenient to use only even numbers for compensators. Column 5 consists of the final changes in rate of grade and gives Column 6 in Table I.

Because of the analogy between the application of compensators in this method and the use of corrections to the middle ordinates of horizontal curves, as computed from string-line notes, this method has been called "String Lining" vertical curves.

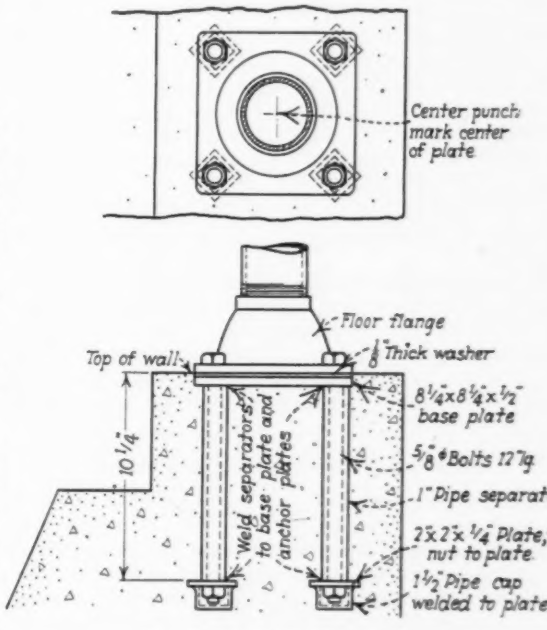
On the Eastern Division of the St. Louis-San Francisco.

Better Details Solve Troublesome Problems

INGENIOUS solutions of two troublesome problems that are frequently encountered in bridge work have been applied recently in grade separation projects carried on by the New York, Chicago & St. Louis at Cleveland, Ohio. One of these relates to the anchoring of the stanchions of pipe railings to the parapets of retaining walls or concrete bridge floors, while the other concerns the design of cast-iron blast plates for use on the underside of structures exposed to cinder blasts from locomotive stacks.

Pipe Railing Stanchion Anchorage

When parapets were built of stone, there was no choice but to drill anchor bolt holes for the anchoring of the stanchions of railings, an operation that could be carried out accurately by using the base or floor flange of the stanchions as a template after the stanchions had been set in place and carefully alined.



Details of the Railing Anchorage

This method is also applicable to railings placed on concrete parapets, if care is taken to insure that no reinforcing bars are so located as to interfere with the drilling of the holes. But this is obviously an expensive process as compared with the embedding of the anchor bolts in the concrete as it is placed.

Better Design Needed

This, however, involves painstaking accuracy to insure good alinement of the railing, since it permits of no means of correcting the alinement to compensate for inaccuracies or accidental shifting of the templates in which the anchor bolts are supported while the concrete is being placed. This defect has been corrected in the past by the practice of enclosing the bolts in pipe separators having an inside diameter somewhat greater than the bolt, so as to permit of some slight shifting of the bolts when the

railing is erected. However, all of these methods have one serious objection in that they provide no means of meeting the problem which arises in the event that the bolts are broken off as the result of an accident, or fail as a consequence of corrosion.

The New Design

It was to meet these difficulties that the Nickel Plate has applied a form of railing anchorage developed by J. M. Heffelfinger, Jr., grade crossing engineer for the City of Cleveland. This anchorage, as shown in the sketch, embodies the essential elements of the usual assembly of anchor bolts and pipe separators, with the addition of a base plate 8¼ in. by 8¼ in. by ½ in., placed at the top of the assembly, together with an individual nut socket placed at the bottom of each pipe separator and consisting of a small plate covered on the underside with a 1½ in. pipe cap. This entire assembly is welded together with the nuts for the anchor bolts enclosed in the socket at the bottom of the pipe separators. These nuts are welded to the underside of the small plates so that the bolts may be readily threaded into them and the nuts prevented from turning.

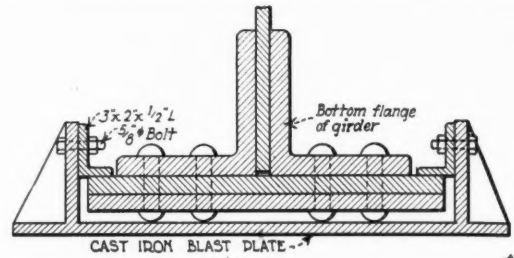
This assembly is erected in the forms, using the anchor bolts as a convenient means for suspending the anchorage from a suitable support. After the concrete has set the bolts are screwed out, the pipe sleeves filled with a light asphalt compound, the base casting of the stanchion is set in place and the bolts are forced down through the compound and screwed home. Any variation in the grade of the railing is corrected by the use of thin shims between the base plate of the anchorage and the base casting of the stanchion.

The advantage of this arrangement is obvious. The threads of the nut and bolt are at the bottom and, therefore, secure against injury and are also protected against corrosion. Therefore, destruction of the top of the bolt does not introduce any obstacle to the removal of the damaged bolt and its replacement by a new one.

Attaching Cast-Iron Blast Plates

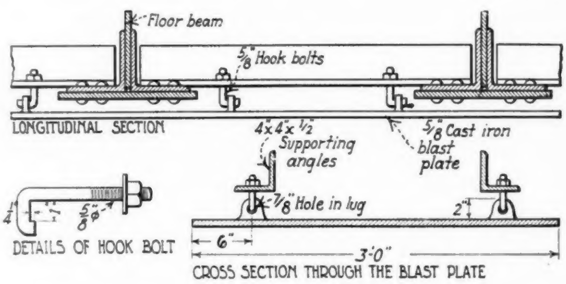
It is a rather common practice to provide cast-iron blast plates on the underside of overhead structures that provide only limited clearance over the tops of locomotive smoke stacks. They are frequently embedded in the concrete of reinforced concrete slab structures, or are bolted to the bottom flanges of girders or beams. The primary problem attending their use has been the ready means for their replacement and this has given rise to the Nickel Plate design in which ready renewal was a primary consideration. These plates, which are all ⅝ in. thick, are of two distinct designs, or combinations of the two. One design is for the protection of main girders and is provided on each side with vertical ribs suitably reinforced by small gusset-shaped ribs. These ribs have 11/16-in. holes at a spacing of 1 ft. 1½ in., for the use of ⅝-in. bolts in making a connection to the 3-in. leg of a 3-in. by 2-in. by ⅜-in. angle, by means of which the plates are supported from the upper side of the bottom flange cover plates of the girders. This is clearly shown in one of the sketches.

The other design of plate is used where the plates must be supported from the lower flanges of steel



Blast Plate Assembly for Girders

beams spanning at approximately right angles to the run of the blast plates. For these plates the means of support are lengths of 4-in. by 4-in. by ½-in. angles spanning between the beams directly over each side of the plate, the angles resting on the upper side of the bottom flanges of the beams. The horizontal flanges of these angles are punched with from one to three 11/16-in. holes for ⅝-in. hook bolts, that are suspended by the nuts from these supporting



Method of Supporting Blast Plates from Floor Beams

angles and hooked into ⅝-in. cored holes in vertical lugs provided at desired locations on the upper sides of the blast plates. The angles and bolts used in this construction are protected by a two-inch covering of gunite after erection, which can be broken off when it becomes necessary to make renewals of any worn or corroded plates.

We are indebted for the above information to G. H. Tinker, bridge engineer of the New York, Chicago & St. Louis, Cleveland, Ohio.

The Railway Industry at a Glance

Operating revenues and expenses of the Class I steam railways in the United States, from data compiled by the Bureau of Statistics, Interstate Commerce Commission

	Month of March 1930	Month of March 1929	Decrease 1930 Under 1929 per cent	Three Months Ending with March 1930	Three Months Ending with March 1929	Decrease 1930 Under 1929 per cent
Total Operating Revenues	$452,716,554	$517,563,318	12.4	$1,331,982,485	$1,481,224,502	10.1
Expenditure for maintenance of way and structures	**61,620,176**	**66,189,139**	**6.9**	**169,707,086**	**180,155,104**	**6.1**
Total operating expenses	351,278,764	377,757,677	7.0	1,038,418,491	1,098,060,343	6.0
Net railway operating income	61,074,228	97,404,527	37.4	176,253,628	259,323,784	32.0

Getting More Service Out of Crossties

Ways to improve quality, obtain longer service life and insure a permanent supply of timber were studied by producers and consumers

IT WAS evident throughout the discussions at the twelfth annual convention of the National Association of Railroad Tie Producers at the Hotel Peabody, Memphis, Tenn., on April 29-May 1, that the production of crossties is undergoing rapid and drastic changes and that railway men are taking a more definite interest in subjects relating to tie production and service. This interest comprises not only the economies of use, but includes methods of production to improve quality, proper means of protecting the wood from incipient decay prior to treatment, and means of insuring a permanent supply of timber for tie manufacture. Frequent mention was made also of the necessity for a consistent policy of forest conservation and reforestation to provide a permanent supply of tie timber for the future.

Reports indicated that while production was light and stocks were normal early in the year, production is now considerably in excess of demand. In the south central states, however, at the close of last year prices had advanced approximately 10 cents per tie over those at the beginning of 1929. In New England the production of hardwood ties has increased while there is a recession in the output of cedar ties.

The Use of Water Oak for Ties

Nearly every trackman prefers to use hardwood ties when he can secure them. He sometimes finds, however, that what at first appeared to be an excellent tie has failed as a result of excessive splitting. One of the woods that give trouble in this respect is water oak. In speaking on this timber, N. W. McGough, treating engineer, Texas & Pacific, Texarkana, Ark., said that "water oak, which is one of the 35 species that have commercial value, grows naturally only on moist bottom lands and adjacent hillsides. This timber splits and checks freely in seasoning, but this trouble can be somewhat minimized by cutting the trees in the late fall or winter months. The tendency to split is frequently so great that S and Z-irons, bolts and even bands are not sufficient to make ties manufactured of this wood serviceable. However, by selecting sound trees, cutting them at the proper season and applying anti-splitting devices immediately and by proper piling during the seasoning period, this wood makes very satisfactory ties. Water oak takes the same preservative treatment and methods as red oak but should be treated to refusal."

Anti-Splitting Devices

One of the serious problems confronting trackmen is that of splitting ties. Those roads which keep an accurate record of the causes for removal are frequently surprised at the relatively large number of ties that fail by splitting. Of late, maintenance men are recognizing that in order to cure this evil, it is not sufficient to wait until the tie is in service to apply measures to control splitting. No methods of controlling the tendency to split after the tie is applied in the track have been found practicable. The time to do this is during the seasoning period, according to C. W. Green, timber treating engineer, New York Central Lines, Toledo, Ohio.

"It has been observed in tie removed from track," continued Mr. Green, "that little excessive splitting is manifest on the under side or face which has set in the ballast, indicating that the area to which the most protection should be given is the face or upper section of the tie. As all ties are not subject to splitting and it is not considered necessary by many to apply devices to every tie used, or to apply more than one device in each end in many cases, the problem becomes one of following a tie that is protected with a device, through from the seasoning yard so that it will be properly laid in

track. With the universal use of tie adzing and boring mills, it would appear possible to give such ties a distinguishing mark to insure that they are adzed on the face that requires the most protection. By this method the proper placing of the tie in track may be insured."

Mr. Green concluded his discussion of this subject with a quotation from a report of the Tie committee of the American Railway Engineering Association to the effect that irons or devices should be placed to cross at right angles the greatest possible number of radial lines of the wood. Irons of sufficient stiffness to permit driving are of sufficient strength to withstand seasoning stresses. Many irons of excessive gage (thickness) are being used with consequent undesirable and unnecessary damage to the wood.

Protecting Crossties in the Woods

While track forces have no direct control over ties before they are delivered to them for distribution, they are vitally concerned with all influences which affect their service life and especially with their care and their prompt removal from the woods after cutting, to avoid the possibility of infection from decay-producing organisms before treatment. No road is more exacting in its requirements in this respect than the Atchison, Topeka & Santa Fe and the Kirby Lumber Company (its producing agency in Louisiana and Texas), which have developed a highly organized routine to bring out and transport these ties to the treating plant seasoning yard with the minimum exposure to infection. These precautions were described by J. R. Keig, manager, Kirby Lumber Company, Beaumont, Tex., his remarks being quoted briefly below:

"We have a rule that all ties must be hauled to the right-of-way as soon as possible after they are made and at any event within 30 days. When ties are placed in the yard for inspection it is required that they be piled two and seven, with at least three feet between stacks to facilitate inspection. Furthermore, the two bottom ties must be elevated at least six inches from the ground. We also make it a point to eliminate the necessity for ties being stacked in water or damp places in tie yards. Each kind of wood is stacked by itself.

"Ties are loaded for the treating plant as soon as possible after they are inspected and in any event before they have been on the right-of-way 60 days. Prompt delivery of ties to the treating plant is, in our judgment, essential to their proper protection."

Developing a Crosstie Supply

To the trackman on the average railway in the northern or eastern states, the problem of insuring a permanent tie supply for the future is one of primary interest. Of late years he has noted the receding forests and the growing practice of buying ties at distant points on foreign lines and has heard frequent reports of a possible ultimate tie shortage. For this reason it will be a source of surprise, as well as relief, to him to learn that for the past five years the New York, New Haven & Hartford has secured 90 per cent of its entire annual crosstie requirements of 1,500,000 treatment ties in New England. In a paper presented at this meeting, F. C. Sheehan, office assistant to the purchasing agent of this road, described the measures by which this result had been brought about.

"New England is not essentially a tie-producing territory," he said, "since the average stand of timber is small, individual tracts being able to produce on the average less than 1,000 ties each. There are only three or four operators who are organized to get out as many as 100,000 ties a year and this is about the limit that one man can handle under the conditions which are found in this territory. In 1920 the tie production in the area served by this road was only 230,000 annually, but through systematic efforts it was developed to from 1,000,000 to 1,400,000 in 1923 and succeeding years.

"At the outset it was apparent that the success of the effort to buy ties locally would hinge on the degree to which co-operation could be brought about between the railway and the tie producers. At this time there was no accurate knowledge of the amount of tie timber available; yet this was essential to any plans that might be formulated. An entire winter was spent in cruising timber and gather other essential data. The survey indicated that from 12,000,000 to 15,000,000 ties were available adjacent to the railway and it then entered the market on a wholesale scale. At every point during the preliminary period and during production there has been wholehearted co-operation between the railway and the producers, including the mechanics of tie manufacture, inspection and delivery, and a completely new system of cutting and handling has been developed.

"The ties are made from logs which are felled during the winter and hauled to the mill without delay. As they come from the saws they are peeled and any necessary trimming is done in the pit. They are then taken to the inspection yard and piled, each tier being separated from the next by one-inch strips. Inspection is made in this yard, and the ties are loaded at once on cars for shipment to the treating plant. Thus all ties arriving at the plant are uniform in their condition of seasoning. The inspector examines every tie with a view to its suitability, not with an eye to the defects upon which he might degrade it, but which could have no bearing upon its fitness for use in its intended grade.

"The New Haven has used an average of 1,500,000 ties annually during the past five years, but looks for a drop in the renewals in the years just ahead. The requirements for 1930 are 1,200,000, and it is expected they will be reduced to 1,000,000 by 1934."

Records Demonstrate Savings

Any device or method which will prolong the service life of ties is a matter of interest to maintenance men, not only because it is a means of reducing the mounting costs of maintenance, but also because better track can be maintained with less effort when tie renewals are reduced to a minimum. C. E. Johnston, president, Kansas City Southern, analyzed the tie records of his road, stating that these records are very complete from 1908, when the use of dating rails was started. From this time, foremen have been required to report all ties removed from track. The report shows the kind of tie, the year installed, the mile on which it was laid and the date of removal.

The record is in such detail that it is a simple matter to ascertain the average life of ties by kinds of wood for the system as a whole, or for any particular territory. The average life of untreated white oak ties in 1920 was 7.95 years, the longest life, 9.4 years, being obtained on the north end of the line and the shortest life, 6.6 years, between De Quincy, La., and Port Arthur, Tex.

Treated oak ties were first applied in 1909, and the percentage of this class of ties used was increased year by year until 1925, since which time all replacements have been made with treated oak ties. It is estimated that 75 per cent of all ties now in service in Kansas City Southern tracks are of treated hardwood. It had been hoped that the treated ties installed on the southern sections of the line would have a life of 10 years or slightly more than the average for the untreated

white oak on the northerly territory. As a matter of fact, present indications point to an average life of 25 years and it is now hoped that this can be extended to 30 years.

The cost of an untreated oak tie installed in the track averages $1.28. If the average life is eight years, the annual cost is, to all intents and purposes, 16 cents a year. Likewise the initial cost of a treated tie is $1.73 and its annual cost, predicated on an average life of 20 years, is 8.65 cents, a direct saving of 7.35 cents annually.

Protection from decay is not sufficient, however, if the full benefit of the treatment is to be obtained. Other forms of destruction such as splitting, rail cutting, breaking, crushing and other forms of mechanical wear and abuse must be prevented or the cost of treatment is wasted wholly or in part. Under increasing wheel loads these difficulties are becoming greater, but can be minimized by the use of anti-splitting devices, tie plates, proper tamping and other devices which are at the command of maintenance officers. In addition to these devices, pre-adzing and boring are perhaps the most important advances made in the preparation of ties since the introduction of creosote.

Substitute ties are constantly being proposed and listed, but none has yet been found that has all of the advantages of wood, and the wood tie probably will remain the standard for many years to come, provided the problems of forest supply are met and solved. On the basis of an average life of nine years, it is necessary to cut a forest area equivalent to the state of Connecticut, in order to supply the annual requirements of all of the railways of the country. Cutting must be done more scientifically to the end that a perpetual supply of timber will be available at a reasonable cost.

Extending the Use of Timber Through Wood Preservation

It is of interest to producer and consumer alike to extend the service life of crossties. To the consumer this means decreased tie renewals. To the producer it means the continuation of the industry which would otherwise be approaching the point of annihilation owing to the receding supply of tie timber. The magnitude of the active promotion of substitute materials for ties is probably not fully realized, except by maintenance officers who are constantly importuned to give them a trial. In view of the insistent demands for greater economies in transportation and the ever-increasing wheel loads of locomotives and cars, there are important possibilities in the potential competition which some of these materials may develop. This warning note was sounded in a paper presented by C. C. Cook, maintenance engineer, Baltimore & Ohio, Baltimore, Md., from which the following is abstracted:

"Untreated ties with a life of 10 years have a capitalized cost of $3.89; a treated tie having a life of 22 years on the same basis costs $2.74; while a composite tie capable of withstanding the loading now used, probably could be developed to have a life of 30 years at a capitalized cost of $3.90. Taking into consideration the advantage of a tie of long life with respect to reducing the disturbance to the track for replacement, the composite tie, though not threatening the treated tie, is seen to have an excellent chance to displace the untreated tie.

"For these reasons, the preservation of timber is essential for the continuance of wood as the one superior material for crossties. These facts leave small margin for inferior treatment, and producers should constantly urge the protection afforded by treatment upon every customer for every purpose except temporary service."

The first report of the total number of ties used by the Class I carriers, according to Mr. Cook, appeared in the records of the Interstate Commerce Commission for 1917. If 10 years be taken as a fair figure for the life of untreated ties, it is apparent that it was approximately true that only the treated ties used prior to 1907 resulted in reducing the renewals for 1917. These ties did not represent any considerable proportion of the total renewals of earlier years, so that it may be said that the figures for 1917, 79,070,201 ties, or 214 per operated mile, represented the demands of the untreated tie situation.

A high point was reached in 1920, with a total of 86,829,309, while in 1922 the total was 86,641,834, or 227 per mile. It is probable that at this time the earlier installations of treated ties were beginning to fail. In any event these dates evidently mark the peak of crosstie requirements for renewal. During the last year of record, 1928, a total of 77,390,941 ties, or 192 to the mile, were used.

The importance of these figures lies in the fact that in 1917 the replacements averaged 214 per mile of road operated, while in 1928, when the use of treated ties had become more general, the replacements averaged 192 to the mile—a reduction of 10 per cent. The roads which did not make extensive use of treated ties until 10 or 15 years ago have now a low requirement, but this will again increase as they approach their future normal requirements.

Complete records of tie renewals have been kept by the Baltimore & Ohio since 1901. An analysis of these records provides a means of determining accurately the average life of both treated and untreated ties. A curve of renewals has been prepared, based on the compilation of the Forest Products Laboratory, which enables a forecast to be made for many years to come. The accuracy of the predictions made in this manner is attested by the fact that the forecasts for the years from 1915 to 1929, inclusive, totaled 34,047,792, while the total renewals during this period aggregated 34,643,568, a difference of less than two per cent. The average renewal for 1917 was 240 to the mile; in 1929 this was reduced to 152 to the mile. The minimum requirement of 124 per mile is expected in 1934. Thereafter there are expected to be successive cycles of increases and decreases, reaching a maximum of 170 and a minimum of 124 to the mile until a stabilized average of 145 per mile is attained.

On another road, during the first five years after the use of treated ties began, from 1911 to 1915, the average renewal per mile was 220. During the last 10 years the renewals have averaged only 90 to the mile, while in 1929 a low requirement of 54 to the mile was reached. For the next five years the average is expected to be about 50 ties to the mile. The inevitable cycles of increases and decreases will then ensue, which will carry the requirements successively above and below 100 ties to the mile, which will finally be about the average annual renewal, based on a life expectancy of 30 years.

If the crosstie market is to be subjected to the cross-currents of increases and decreases with probabilities of general recession as cited, what constructive measures may producers adopt? The answer is to extend the use of treated timber for any and all purposes for which it is suited. Probably there are none that could not extend his operations to include also dimension timbers and yard lumber of various sizes and kinds of wood to meet divers purposes in the construction and maintenance fields.

What's The Answer?

Have you a question you would like to have someone answer?

Have you an answer to any of the questions listed below?

QUESTIONS TO BE ANSWERED IN THE AUGUST ISSUE

1. *What effect, if any, does the canting of rails have on the development and growth of transverse fissures?*

2. *What are the relative advantages and disadvantages of concrete and brick for station platforms?*

3. *In renewing ties, what precautions should be taken to avoid injury to the men engaged in this work?*

4. *Where some effective method of spacing ties is provided, is the inside metal guard rail a satisfactory substitute for the outside guard rail for open deck bridges? Does it have any additional advantages? How does the type of structure—through or deck steel spans or ballast deck trestle—affect the value of its use?*

5. *What is the most practical method of keeping down the dust at highway crossings during dry weather?*

6. *When laying pipe lines, what precautions can be taken to prevent or minimize leaks at a later date?*

7. *In reballasting on multiple tracks, should the surfacing be done with or against the traffic? Why?*

8. *Can leakage through the joints of interlocked steel sheet piling be prevented? If so, how?*

Inspecting Water Stations

What provision, if any, should be made for the inspection of water stations at regular intervals? By whom should this be done and what details should receive most attention?

Regular Inspection Keeps Officers Informed

By Engineer of Water Service

It is impracticable for supervisory officers, even those who are in closest touch with the various facilities under their charge, to know all of the details relating to the condition of the equipment at plants as numerous and widely separated as the water stations on the average division. It is much more difficult for district or general officers who cover a larger territory to obtain or keep this information in mind.

Since so much depends on the reliability of the equipment which is installed for the delivery of water to locomotives, it is important that this information be available currently to those officers who are responsible for the continuity of the water supply. The best means of collecting and recording information of this character is through a system of inspection and reports at regular intervals.

The local or division inspection should be made at least four times a year by the division supervisor of water service, and should cover every detail of plant equipment, including the pumps, the driving equipment, tanks, tank spouts or water columns, valves and fuel storage. If the plant is steam-driven, the boilers and steam lines should be examined to ascertain that all valves and safety equipment are in place and in good condition and to observe whether there are any leaks. If internal combustion engines are used, their condition should be noted. Fuel lines and storage should be given particular attention to insure that they are in safe condition and do not present a fire hazard. If the pumps are motor driven the motors should be examined and their condition noted. Incoming power lines and switches should be observed for loose connections, defective supports, bare wires and other defects which will affect the dependability of the power supply or cause a fire hazard.

The hoops on wooden tanks should be inspected as well as float valves, tank valves and other details which control the storage and delivery of the water. This inspection should also include the tank frame and foundation, the staves and floor of the tank and the tank spout. Steel tanks should be examined for settlement, leaks at seams or around connections and the condition of the paint.

Water columns should be examined for leaks, to ascertain the condition of the valves and operating equipment and the foundation pits and drainage. Intakes and deep well pumping equipment should be inspected carefully to ascertain whether there are any conditions which are likely to curtail the water supply. If the water is being treated, the chemical mixing and applying equipment, the sludge drainage system, the filters and other special devices should be inspected and the plant operator questioned to ascertain that the equipment is in good condition and is being operated according to instructions.

Leaks in suction and discharge lines or at defective valves frequently result in substantial loss and may affect the dependability of the service. For this reason special effort should be made to ascertain whether such leaks are occurring and what can be

done to overcome the trouble. A large amount of waste may result from having water columns too high or too low to correspond with the height of engine tanks and this feature should also be observed.

In a steam-driven plant it is seldom practicable for the water service department to inspect the boilers properly. For this reason arrangements should be made with the mechanical department for inspecting and testing the boilers and issuing certificates of inspection.

It is advisable that a complete report of all regular inspections be made and that copies be furnished to the division engineer and the engineer of water service. Late in the year, prior to the preparation of the budget, the system water inspector, the supervisor of bridges and buildings, the division engineer and, if practicable, the engineer of water service, should accompany the supervisor of water service at the time he makes his inspection. From the data obtained at this time, the budget for the ensuing year can be prepared, while all of these officers will have first-hand knowledge of the condition of the water stations under their jurisdiction.

No effective or economical system of maintenance is possible without definite knowledge of the requirements for each plant or territory. There is no better method of obtaining this knowledge and keeping it currently correct than through a system of regular inspection and full report of the conditions as they exist.

Regular Inspection Should Be Required

By Superintendent Water Service

Periodical inspection of water stations at regular intervals is desirable and necessary to their safe and economical operation as well as to insure dependable service.

On one middle western railroad, the water stations are inspected quarterly by the division supervisor of water service, who reports the results of his inspection to the superintendent of water service and the division engineer. Annual inspections are made jointly by the division supervisor of water service and the system water inspector, who is a member of the staff of the superintendent of water service. The reports of both of these inspectors are made on standard forms which provide space for all of the essential information which should be recorded, separately for each water station. The annual inspection is used as a basis for the preparation of the maintenance program for the ensuing year. In addition to these regular inspections, which include every feature of the equipment at the individual stations, the boilers at steam-operated water stations are subjected to an annual inspection and test by a boiler inspector.

As was stated at the beginning, the purpose of water station inspection is threefold: Safety, economy and continuity of service. Some of the principal items affecting the safety of water stations are careful inspection of water tanks to avoid their collapse through failure of hoops, frame or foundation; the inspection of boilers at steam water stations to insure their safety and proper operating conditions; the inspection of air reservoirs used in starting internal combustion engines, and last, but not least, the careful inspection of fuel lines and storage of gasoline and oil operating stations for the purpose of preventing damage from explosions and fires.

The economical operation of water stations requires first of all a carefully considered program of expenditures which can only be arrived at through a detailed inspection. Economical operation of water stations also demands frequent and detailed inspection to avoid losses through leaks and wasteful practices not only from tanks and pipe lines but from other sources which would involve material losses.

The uninterrupted operation of water stations requires that the facilities be kept in first class condition at all times, and proper inspection is essential to the efficient operation of the facilities. With a well-organized water service department, water stations are under constant inspection by pumpers, repairmen and supervisors of water service, as well as other division officers, but a periodical inspection covered by written report is essential to the most satisfactory operation and maintenance.

Spacing Anti-Creepers

Should anti-creepers be spaced uniformly throughout the rail length or grouped at certain points in the panel? Why?

Should Always Be Spaced Uniformly

By A. D. Henninger
Extra Gang Foreman, Minneapolis, St. Paul & Sault Ste. Marie, Moose Lake, Minn.

In my opinion anti-creepers should be spaced uniformly throughout the rail length. The ballast between the ties provides most of the resistance against the movement of the ties which are used for anchorage purposes. This resistance is considerably increased, however, by the friction between the tie and the ballast upon which it rests. If the anti-creepers are spaced uniformly throughout the rail, the strain set up by the tendency of the rail to creep is distributed over the whole body of ballast. If, on the other hand, the anti-creepers are grouped at certain points, the entire body of ballast does not function to resist the strain, the ties are more likely to shift and it usually happens that considerable churning is in evidence. Anti-creepers should never be placed at or opposite joints or on the shoulder ties; this applies more particularly to suspended joints.

Number Is More Important Than Distribution

By W. C. Rourk
Section Foreman, Texas & Pacific, Waskom, Texas

So far as my observation goes, it makes little difference whether anti-creepers are applied uniformly throughout the rail length or are grouped at certain points. If there is any advantage, however, I believe that the best practice is to distribute them uniformly throughout the rail length, since this method would seem to give a better distribution to the reaction of the ballast against the movement of the rail and ties.

In my opinion a matter of greater importance than the different methods of distributing the anti-creepers along the rail is the question of providing a sufficient number of anti-creepers to insure that the rail will be positively anchored against movement in either direction. On single track, the only way to accomplish this is to apply four anti-creepers to every tie that is selected for anchoring purposes, thus anchoring the track in both directions. Joints should not be slot spiked, neither should anti-creepers be applied opposite joints. If rail is laid with the correct allowance for expansion and sufficient anti-creepers have been applied at once to hold this expansion uniform at all joints, the tendency to run or sun kink will be practically eliminated. As a result there is no opportunity for ties to slue and cause

tight gage and the joint ties can more easily be maintained on a solid foundation. While the application of the extra anti-creepers, that make the difference between well-anchored track and track that is indifferently anchored, adds to the cost of the installation, this is negligible when compared to the cost of re-adjusting slued ties, driving rail, regaging and relining the track.

Special Cases Require Different Treatment

B. J. J. Hess
General Roadmaster, Great Northern, Seattle, Wash.

In general, there is an obvious advantage in spacing anti-creepers uniformly throughout the rail length, since this results in a better-distribution of the stresses in the rail, ties and roadbed. This statement is not always true, however, for those cases where the opposite rails in a track do not creep uniformly. Neither does it apply to those freakish cases, which I have never been able to explain, where the rails creep in opposite directions regardless of the direction of the preponderance of traffic or the rate or direction of grade. These conditions exist on many railways and must be taken into account when installing anti-creepers, so that the number and distribution of the anchors must be made to correspond with the requirements of these special cases.

While it is possible to make a uniform distribution of the anti-creepers in any rail length, additional anti-creepers should be applied on the approaches to bridges, switches, railway crossings and each side of insulated joints. This should also be done where frequent or heavy brake applications are made, as on the approaches to stations or water tanks. I would be very much interested in finding a solution of the cause of rails creeping in opposite directions regardless of traffic or grade.

Erecting Steel Bridges

Under what conditions is it advantageous to erect steel bridges of moderate span with company forces? Under what form of organization?

Does Not Favor Company Erection

By I. L. Simmons
Bridge Engineer, Chicago, Rock Island & Pacific, Chicago

The discussion of this question is based on the practices which are considered as being best adapted for those railways that do not maintain a permanent system organization of structural steel workers, which is fully equipped to do all classes of steel erection and steel bridge maintenance, and refers more particularly to work that is ordinarily done by divisional organizations under the direction of the division engineer or master carpenter.

On the basis of these assumptions, I would confine steel bridge erection by company forces to those spans that come fully riveted so that the work of erection involves only the removal of the old structure and the placing of the new one. Divisional organizations seldom are equipped with sufficient tools to assemble and rivet a span properly in the field and it is very rarely that they have men who are qualified to do a first class job of riveting heavy bridge members.

Very few divisions ever have a sufficient amount of erection work to warrant the expense of organizing and equipping division structural gangs. If such gangs are maintained there will be a great deal of duplication of machinery and tools over a railway, most of which will be idle a large part of the time. For these reasons, I am of the opinion that the erection of steel spans by company forces should be confined to the placing of short spans that can be handled readily with the derrick equipment ordinarily furnished to the division organization.

Depends on the Character of Organization

By C. C. Westfall
Engineer of Bridges, Illinois Central, Chicago

In answering this question, consideration is given primarily to those railways that maintain system structural steel gangs and have in these organizations foremen who are competent to handle erection jobs and sufficient men experienced in this class of work to form at least the nucleus of the necessary erection organization. It is necessary for this purpose that there be modern equipment, including a full complement of air tools, to permit the work to be done economically. Unless these essential conditions are fulfilled, it is the writer's opinion that it would not be advisable to undertake any class of erection with company forces, except short deck-plate girder and I-beam spans.

If the railway has the requisite organization, the character and kind of equipment it should provide will be governed by the kind of erection work that is to be done. Certain classes of erection require heavy equipment of unusual character which the railway would not be justified in owning because of the infrequency of its use. An example is a traveler for the erection of viaducts or long truss spans. While the individual spans and individual sections of columns in viaduct work can be handled easily with the ordinary erection equipment usually found on the railways, this can not be done economically and the most satisfactory method is to use equipment especially designed for this class of erection. Whether movable bridges of even moderate span should be erected by company forces will depend on the experience and ability of the company organization.

In the opinion of the writer, it is of considerable advantage to have all erection work that may interfere with train operation handled by company forces since the work is then in direct charge of men familiar with train schedules and the requirements of operation, so that the work can be subordinated to the needs of traffic as this becomes necessary.

There may be cases where erection work could be handled by division organizations, but the writer is not familiar with them. It is his observation that there is seldom sufficient steel erection work on any individual division to warrant the maintaining of a division organization with men of the requisite experience in erection. Furthermore, it is almost, if not entirely, impracticable to carry a full line of erection equipment and small tools on each division. Nor would it be practicable to attempt to keep together a full set of such equipment if it is to be transferred from one division to another.

It has been the experience of the writer that bridge erection can be handled satisfactorily and economically by means of a system organization properly equipped for this class of work. We have erected both through pin-connected and riveted fixed spans of all lengths up to and in excess of 200 ft. and movable bridges and viaducts, and have done the work economically. In view of this experience, it is my opinion that the amount of steel erection with which

the railway is faced, the extent of the structural organization and equipment, and the character of the work involved will determine whether there is any advantage in handling the work with company forces.

Breaking of Wing Rails

What causes the wing rails of spring frogs to break opposite the frog point more frequently than elsewhere? What means can be employed to prevent this?

Changed Planing of the Base of the Wing Rail Eliminated Breakage

By J. A. S. Redfield
Assistant Engineer Maintenance of Way, Chicago & North Western, Chicago

As the result of a number of cases of wing rails in spring frogs breaking opposite the frog point, this matter was made the subject of investigation some time ago. Since these breaks all occurred substantially at one place, it was decided that our former practice of cutting a square notch out of the base flange of the wing rail, at a point slightly in advance of the point, was the reason for the breaking of the wing rail at this particular location.

We have since redesigned our spring frogs to eliminate this feature of the original design. The plans now require the planing of the flange of the wing rail from the point of flare to the ½-in. frog point on a line which is the vertical projection of the gage side of the head. From this point, the full section of the rail base near the throat of the frog is connected to the line of planing by a circular curve having a 5-in. radius. As an added precaution to increase the general stiffness of the frog where it receives the most abuse from the car and locomotive wheels, we have placed a ⅝-in. plate under the point and extended it across the two ties which support this section of the frog. We believe that this change in the design of the wing rail has been sufficient to overcome the condition which was causing the breakage and this belief is confirmed by the fact that we have had no similar breakage in frogs constructed in accordance with this plan.

Notching the Flange of the Wing Rail

By W. P. Cronican
Chief Draftsman, Illinois Central, Chicago

The breaking of wing rails of spring frogs opposite the frog point was quite common on the Illinois Central a few years ago. This trouble occurred more frequently, however, after the adoption of open-hearth steel rails. An investigation which was made to determine the cause disclosed the fact that the breaks originated almost invariably at the point where the flange of the spring rail was notched just ahead of the point to give the necessary clearance to permit the wing rail to fit tightly against the point when closed.

In searching for a remedy, it was found that by planing the base of the wing rail on a line with the head of the rail, thus bringing it parallel with the planing of the point, this notch could be eliminated without detriment to the strength of the wing rail or its operation. This simplified the construction of the frog, since it requires only one continuous cut from the flange of the wing rail between the point of flare and the throat of the frog. This method of construction gives a full base width for the wing rail at a point about 16 in. ahead of the ½-in. frog point on a No. 10 frog, which is the one most commonly used as a spring frog.

This method of planing leaves a triangular opening just ahead of the frog point which trackmen on the Northern lines of this road say is a decided advantage in reducing the accumulation of snow and ice at this point. So far as the writer has been able to ascertain, this change in the method of constructing the wing rail has completely eliminated the breakage of wing rails at this point.

Center or Side Dump Cars

What are the relative advantages of side and center-dump cars for distributing ballast for ordinary reballasting operations?

Save Labor and Eliminate Waste

By J. J. Hess
General Roadmaster, Great Northern, Seattle, Wash.

Cars of the side and center-dump type afford a great opportunity to save labor and eliminate the waste of material which has so frequently occurred in unloading ballast from the ordinary type of center-dump cars. By using cars of this type the ballast can be distributed more uniformly, both in the center of the track and on the shoulder, thus reducing the amount of labor which would otherwise be necessary for equalization. At the same time the unloading of the ballast can be controlled to correspond with the amount of raise that is to be given the track.

After the raise has been completed, this type of car is ideal, since the amount of ballast required to fill the track and complete the shoulder can be unloaded as required, so that little rehandling is necessary. For these reasons, the use of this type of car is of distinct advantage when compared with those types which permit the unloading to be done only at the side or center.

The Combination Car Is Most Advantageous

By William Shea
Assistant Engineer Maintenance of Way, Chicago, Milwaukee, St. Paul & Pacific, Chicago

In ordinary reballasting operations there is usually considerable variation in the amount of ballast required to raise the track to the proper elevation, even over limited stretches, particularly where short sags occur in the existing grade. While some difference can be made in the amount of ballast unloaded from the ordinary type of center-dump car, this feature is seldom under good control. The result is that the distribution of the ballast rarely conforms to the requirements. In other words, with this type of car it is extremely difficult to control the unloading so that there will be sufficient ballast for the heavy lifts without getting an excess at the points of little raise. The principal advantage of the center-dump car is that a large amount of ballast is unloaded between the rails where it can be used without rehandling when the track is lifted.

In using side-dump cars, the gravel is unloaded on the shoulder, and while it is often somewhat easier to control the distribution with this type of car, this method of unloading requires a large amount of rehandling to permit the tamping to be done between the rails. Since this rehandling must be done by hand labor, the cost is high and usually some amount of dirt finds its way into the new ballast.

When the final distribution is made of the ballast

for finishing and dressing, the same difficulties are experienced with both the side and center-dump equipment. Furthermore, with both types of cars an excessive amount of hand labor is required, thus increasing the cost of dressing beyond a reasonable figure.

Of late we have been using a type of car that permits the ballast to be dumped at either the side or center or, if desired, at both the side and center simultaneously. The method of controlling the flow of ballast is such that there is no excuse for unloading an excess of material at any point, while within practical limits any quantity can be unloaded to provide material for heavy lifts to eliminate short sags. When unloading for finishing and dressing the track, the distribution can be controlled so that the unloading becomes a matter of judgment. With an experienced foreman in charge of this operation, we have practically eliminated rehandling and trucking in this operation.

Placing Bents Under a Steel Span

Where it is necessary to place intermediate bents under a steel span, what precautions, if any, should be taken?

Different Types Require Different Treatment

By Engineer of Bridges

Different types of structures and the diverse conditions which are met at the various bridge sites require various methods of placing intermediate bents when it becomes necessary to support spans in this manner. In general, for both ordinary and important structures, the erection plans should be worked out in the drafting room to show in detail all the members involved and the methods of support at the bents, and clear instructions should be prepared for the successive steps necessary to carry out the work.

If the structure is a deck plate girder, the best locations for the bents are at the quarter points, provided there is sufficient stiffness in the girders to take the change in stresses which will occur as a result of selecting this position for the bents. Placing the bents in this manner has the advantage that it usually affords a better center opening for high water and drift. If the stream conditions are normal, then it is probably most satisfactory to place the support at the center of the span, since this is the most economical.

In through plate girder spans the simplest procedure, so far as the girder is concerned, is to place the bents directly under each of the floor beams. Stream conditions or the necessity of eliminating obstructions to highways seldom permit this to be done, however. Furthermore, certain stress conditions in the floor system frequently make this method of support inadvisable. Under such conditions, the longest span lengths, with the proper number of piles or posts in the bents, should be worked out for the particular problem under consideration.

In both of the foregoing types of structures, some method must be developed for transmitting and distributing the stresses imposed by the reactions of the intermediate supports, since the web itself does not have sufficient stiffness to do this and the usual stiffener angles are seldom adequate for this purpose. If the supports are to be used permanently, it is desirable to apply additional stiffening angles, either bolted or riveted to the web. If the condition is only temporary, the distribution of the stresses can be accomplished by inserting one or more hardwood posts which are forced in between the flanges of the girder or wedged in such a manner as to insure that they are under initial compression.

In through truss spans the river conditions often vary between wide limits, from normal to high-water stages, and during the latter there may be considerable drift. If the panels are short, intermediate bents at every panel point are likely to cause serious obstruction to the waterway, with an attendant accumulation of drift and possible scouring of the bed of the stream, either or both of which might result in considerable damage to the structure or even complete failure. In this case, calculations should be made to determine the best points for placing the intermediate bents, from the standpoint of economy as well as to allow the largest possible openings for the passage of the current and the drift.

Where the panels are long and the condition of the structure demands that bents shall be placed at alternate panel points, careful study should be made of the stresses which will be developed in the several members, since the stresses in certain web diagonals will be reversed. If these tension members have sufficient section, they can often be converted into compression members by placing stiff wooden struts lengthwise between the bars, wedged tightly between pins or chord points. Every member should be analyzed carefully and the method of treatment should be worked out to fit the particular conditions which accompany the changes in stress which take place as a result of the reactions that are set up by placing the bents at the various panel points.

Three Factors Must Be Considered

By Engineer of Design

In answering this question, it is assumed that the problem relates to an old span which must be reinforced to permit it to carry loads in excess of those for which it was designed. In general, however, the same considerations are involved in the case of an old span that is placed on falsework for the purpose of dismantling it, although in some respects the situation is different.

Three factors enter into the problem of blocking up an old span on bents, namely, the security of the bents, the method of applying the load from the span to the bents and the effect of the intermediate supports on the distribution of stresses in the span. The question of the security of the bents is of primary importance, because a satisfactory answer to this question will determine whether the use of bents will provide a practical solution of the problem of the weak span. It involves such considerations as a satisfactory foundation for the bents, danger of scour and the effect of the bents as an obstruction in the stream that will form a lodging place for drift. To place an intermediate bent in a stream that is subject to the flow of large quantities of drift material during high water might easily result in serious hazard to the structure.

The question of adequate foundations involves the matter of foundation material capable of developing sufficient pile-bearing pressure to insure adequate support for the bents. An excessive depth of water is also a serious disadvantage because of the difficulty of bracing the bents effectively. On the other hand, exposed rock as a foundation has its disadvantages since it entails the use of frame bents and the problem of securing them against lateral displacement.

This is obviously a serious matter in a stream subject to rapid flow, even if the flow is confined to short intervals of time.

The second factor to be considered is the manner of providing the support for the span on the bents. This is ordinarily taken care of by the use of double wedges driven home and thoroughly secured. On the whole, a satisfactory bearing for a steel span on a bent is readily obtained, but in some cases, especially in truss spans with eye-bar bottom chords, it may be necessary to devise some form of a shoe at the lower end of the intermediate posts to serve as a bearing.

One phase of the problem of supporting spans on bents which may easily be overlooked, but which nevertheless is very important, is the effect which the intermediate support may have on the distribution of stresses in the span. The problem is found in its simplest form in the case of the plate-girder span. As is well known, the application of the end reactions of a girder span to the end bearings is effected by means of a group of vertical stiffener angles connecting the top and bottom flanges directly over the end bearings. In a word, these end stiffeners, with the part of the girder web between them, serve as a column of adequate size to carry the end reaction of the girders to the bearings. Therefore, if in any case it is necessary to provide support for the girder at some intermediate point, it is necessary to provide construction directly over the point of bearing which will function as a column. Obviously, the unsupported web of the girder cannot serve this purpose and the crimped intermediate stiffener angles are usually inadequate. The solution, therefore, lies in providing additional uncrimped stiffener angles bolted to the web, although a much simpler method of accomplishing the same purpose is to introduce a pair of 6-in. by 6-in. or 6-in. by 8-in. timbers, preferably of hard wood, cut to a length that will just permit them to be driven between the inside faces of the bottom and top flange angles. To insure a good job, these posts should be held in place by two or three bolts passing through holes drilled through the web, or, in the event that it is practicable to locate these wooden stiffeners at a pair of intermediate stiffener angles, to knock out two or three rivets in the steel stiffeners and pass the bolts through the rivet holes.

In a truss span, the problem becomes more complicated and, in general, calls for a stress analysis of the span under the conditions imposed by the introduction of the intermediate supports. While the additional supports result in a decrease in the stresses in the chord members, they also give rise to a reversal of stresses in certain of the web diagonals and, in the case of the pin-connected span, this may easily result in imposing compressive stresses on eye-bar diagonals.

The case which introduces the least complication is the deck truss span. Bents placed under the first panel points from each end of the span will reduce the effective span lengths by two panels and, in general, will introduce no complications of stress distribution. In a through truss span, on the other hand, bents at the first panel point from the end would come directly under the hip verticals which, ordinarily, are entirely too light to carry the load of the intermediate panels to the bents. The placing of bents at all panel points would, of course, solve the problem, but except where such bents are to be used as falsework for the removal of spans, such a procedure would hardly be justified.

Painting Galvanized Sheets

What, if any, advantage results from painting galvanized sheets used as roofing or siding on railway buildings? How should the surface be prepared for painting?

Can See No Advantage

By Roy Hahn

Clerk to Master Carpenter, Seaboard Air Line, Tampa, Fla.

Personally, I am unable to see any advantage which may result from the painting of galvanized sheets used as roofing or siding on railway buildings, from the standpoint of savings in the cost of maintenance. In the first place, if the sheets have been given a proper coat of galvanizing, they do not require painting since the galvanizing is done only to protect the underlying metal from corrosion and paint will add little to the protective value of this coating. In the second place, if the galvanizing has not been done properly the sheets should not be used, since, in this case, the railway is paying for something it does not get.

It often happens, however, that it becomes desirable to apply paint to galvanized roofing or siding for the purpose of having all buildings, either isolated or in groups, conform to the standard color of the road. In this event, the galvanized surface should be prepared by washing it thoroughly with vinegar. After the metal has dried, the paint will adhere to it with a fair degree of success.

Experience has also shown that if the metal can be left exposed to the weather for a period of about six months and then cleaned with a light sand blast, the surface will be in condition to take the paint.

Most of the difficulties which are experienced in painting galvanized surfaces can be traced to improper preparation of these surfaces. Even with the closest attention to the cleaning of the metal and selecting and applying the paint, however, most jobs of painting galvanized surfaces are not entirely successful.

Watch Cleaning and the Quality of the Paint

By Supervisor of Bridges and Buildings

The purpose of galvanizing metal sheets used for roofing and siding on buildings is to protect the basic metal from corrosion, and under ordinary conditions there is little to be gained from applying paint to sheets thus protected. In railway service, however, especially around shops and terminals, the atmospheric conditions are unusually severe. The result is that the life of this material is definitely shortened as compared with the life of similar sheets used under more favorable conditions.

For this reason, there is a distinct advantage in painting galvanized sheets which are used on railway buildings since the life of the material usually can be prolonged out of proportion to the cost of painting. Another reason, which often applies to the painting of buildings in which galvanized sheets are used, is the desirability of having all buildings in a group painted in accordance with the color standard of the railway.

In preparing the sheets for painting two methods are open. In either case, however, it is desirable to allow the sheets to weather for several weeks before the paint is applied, since it will then adhere to the surface better than if it is applied to fresh galvanizing. In using the first method, the proper period of exposure is determined by the fact that the metal surface begins to show a slight discoloration. At

this time it should be washed thoroughly with diluted vinegar and allowed to dry, and the paint should then be applied.

In the second method the weathering is allowed to continue for several months before painting. The surface is then prepared by sand blasting to remove the surface film which still adheres to the metal and any dirt which may have collected in the meantime. All that is necessary is to clean the surface thoroughly and care should be used to avoid cutting into the galvanized coating. After this is done, the paint should be applied immediately.

In painting galvanized surfaces, it is important that the proper kind of paint be used. Experience has shown that coal tar products or paint containing even a small proportion of such products is entirely unsuited for this purpose. The drying of the painted sheets should not be forced, since this will result in an unsatisfactory job. The paint for this purpose should be thoroughly mixed in pure linseed oil to which a minimum amount of the best quality of drier is added. Benzine should never be used as a drier, nor should the drying be accomplished by heat. The first or priming coat should be allowed to dry thoroughly and harden before the final coat is applied. Practically all of the trouble experienced in painting galvanized surfaces is traceable to improper cleaning, failure to use pure linseed oil or the use of too much drier.

Maintaining 39-Ft. Rails

What precautions, if any, are required in maintaining track where 39-ft. rails are used, that were not necessary with 30-ft. or 33-ft. rails?

There Is Little Difference

By H. R. Clarke
General Inspector of Permanent Way, Chicago, Burlington & Quincy, Chicago

The method of handling 39-ft. rails differs little from the methods which are necessary to secure proper results with either the 30-ft. or 33-ft. rails. For this reason, we have made very little change in our methods of maintaining track since adopting 39-ft. rails as standard.

The greater length of the rails requires fewer joints to the mile and for this reason we use a little more care when laying the rail to insure the proper expansion. The same degree of care should be used with the shorter lengths, but this becomes of greater importance as the length of the rail increases.

In surfacing track it is the common practice to set the jacks at the joints and centers. When this is done with 33-ft. or shorter rails, the quarters ordinarily come up with the jacks. When a lift is made on 30-ft. rails of 100-lb. section or lighter, with the jacks in this position, the quarter seldom comes up to true surface, so that it is necessary to keep a close watch on this when surfacing. The ordinary procedure is to have a man with a lining bar, ordinarily one of the jack men, double back and nip a tie slightly in the quarter. This is usually sufficient to bring this part of the rail to true surface and a tamper can "catch" one of the ties to hold it. Rail sections of 110-lb. and heavier have greater stiffness, so that this difficulty is not experienced where the heavier sections are used.

These are the only precautions we have found it necessary to observe in ordinary maintenance. In laying rail with the lighter types of rail-laying cranes, however, owing to the increased weight and slightly longer boom radius, we have been compelled to be somewhat more careful in counterweighting the cranes. Also in loading the 39-ft. rails, it is necessary to locate the loading equipment so it will be centered on the car, which is generally 40 ft. long, as there is only a small margin at the ends of the car when the load of rail is properly centered.

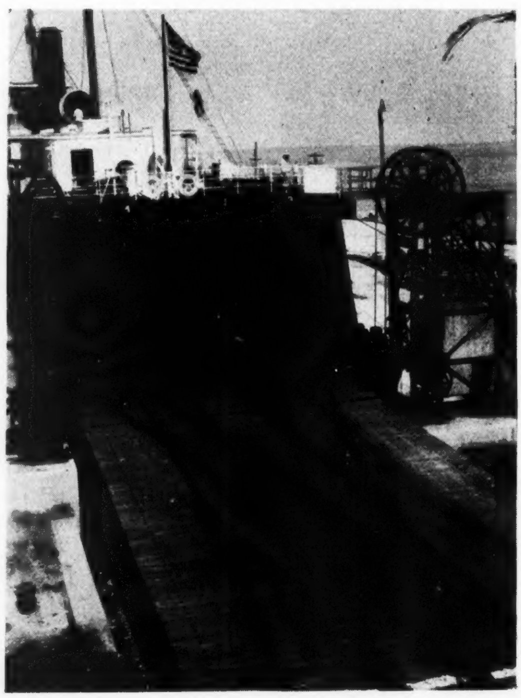
Jacks Are Set at 13-Ft. Intervals

By William Shea
Assistant Engineer Maintenance of Way, Chicago, Milwaukee, St. Paul & Pacific, Chicago

The maintenance of track laid with 39-ft. rails requires very little change in methods as compared to track in which 30-ft. and 33-ft. rails are installed. The principal precaution must be observed when surfacing and this applies to both out-of-face work and the lighter lifts when smoothing up. It has been the general custom when surfacing track to set the jacks at the joints and centers. While a good surface can be obtained by this method with 30-ft. and 33-ft. rails, it soon becomes apparent that a change in the location of the jack is necessary when 39-ft. rails are used.

When surfacing 39-ft. rails, we set the jacks at the joint on the line rail and at the third points for intermediate lifts. This spaces the jacking points at regular intervals of 13 ft. and brings the rail to true surface throughout its length. This system of setting the jacks does not give a lift directly at the joint on the gage rail, and while the remainder of this rail is brought to true surface the joint is generally left a little slack and it is usually necessary to set a jack at this point and give it a slight lift.

In lining track we have found it desirable to use the same system, setting the liners at the 13-ft. intervals on the line side and make a slight adjustment at the joint on the gage rail.



A Grand Trunk Car Ferry

New And Improved Devices

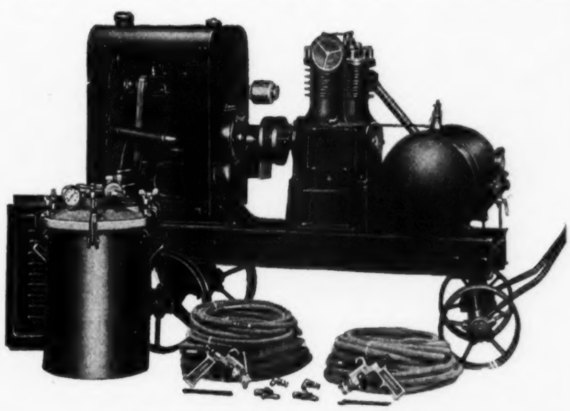
New Rod Increases Speed of Arc Welding

A NEW welding rod designed for carbon arc welding and known as Weldite C-No. 6 Fluxed, which is said to increase the speed of rail-joint welding by about 30 per cent, has been developed by the Fusion Welding Corporation, Chicago. The deposit of the rod is reported to be strong, ductile and readily machinable. The ease and speed of manipulating the arc when using this rod is said to be due to a flux coating which causes the arc to act upon the hottest part of the weld puddle rather than upon the colder edges. When welding rail joints, it is claimed that only one layer of deposit metal is required and that the rod may be laid in place or held in the hand as the welding progresses. This rod is designed for the welding of rail joints rather than for the building up of battered rail ends.

Spray-Painting Outfits Improved

DURING the last year, the DeVilbiss Company, Toledo, Ohio, has effected a number of changes in the design and construction of its Models TN and TNS portable spray-painting outfits, which are calculated to increase the capacities of the machines and at the same time reduce their sizes and weights to a considerable extent.

Among these changes the speed of the compressor of each outfit has been reduced from 700 revolutions



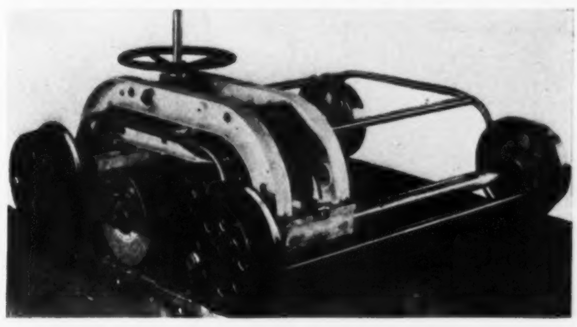
A DeVilbiss Spray-Painting Outfit

per minute to 600 r.p.m., the bore of the air cylinder has been increased from $3\frac{1}{2}$ in. to $3\frac{11}{16}$ in., and the length of the stroke was increased from 4 in. to $4\frac{1}{4}$ in., thus effecting an increase in the displacement from 31 to $31\frac{1}{2}$ cu. ft. of free air per minute.

In addition to these improvements, the overall dimensions and weights of the two outfits have been reduced considerably. The overall measurements of Model TN were reduced in length from 73 in. to $62\frac{7}{8}$ in., in width from 35 in. to $28\frac{3}{8}$ in., and in height from 58 in. to 47 in. Similarly, the length of Model TNS was reduced from 72 in. to $62\frac{1}{2}$ in., the width from 26 in. to 22 in., and the height from $46\frac{1}{2}$ in. to 35 in. Also, the weight of each model has been decreased by more than 150 lb.; Model TN from 1065 lb. to 910 lb. and Model TNS from 1000 lb. to 810 lb.

New Model Rail Grinder Developed by Syntron

A NEW model electric grinding machine for dressing to surface welded rail joints, frogs and crossings, has recently been developed by the Syntron Company, Pittsburgh, Pa. In the design of this new model, an attempt was made to obtain a simple machine of the smallest possible weight and yet strong enough to meet the most exacting needs of rail-grinding service. This equipment consists of a 14-in. grinding wheel powered by a three-horsepower electric motor, which are mounted on a four-wheel light track car or carriage.



The New Model Electric Grinder

The frame of the carriage is of welded tube design with two ground tubular axles. The wheels are of the wood-spoke type and are insulated. The frame, which carries the grinder motor, is constructed of cast aluminum and the motor table, which is mounted in this frame, moves laterally with the track and is raised and lowered by means of a hand wheel. The grinding wheel can thus be lowered to a sufficient depth to grind the side of the head of the rail. The entire equipment weighs less than 400 lb. and two men can easily remove it from the track, while in emergency one man may clear the way by tipping it over.

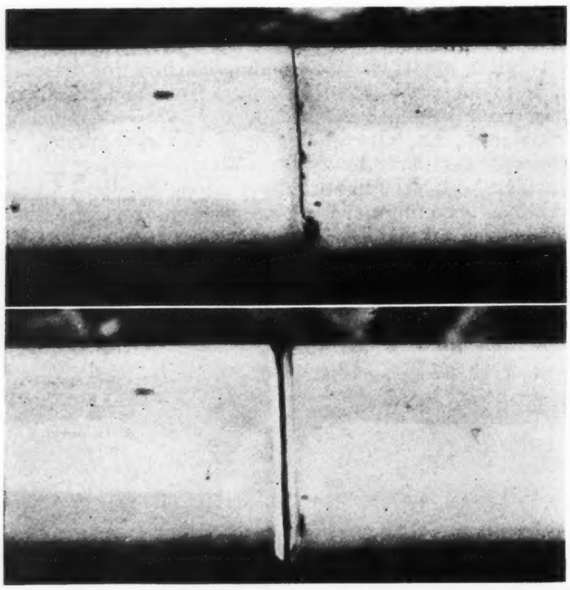
A distinctive feature of this machine is the fact that the grinding wheel can be alternated between the rails and is easily swung to operate on the opposite rail by loosening the center pin that holds the motor and lift-

ing the lock pin that holds it in place. The motor and grinder are then swung through an angle of 180 deg. to a point where the lock pin can be again engaged and the center pin is tightened with a hand wrench. The machine is designed to operate from an electric arc-welding outfit, or power may be derived from a small gasoline-electric generating plant. The starting switch is weather-proof and the connection to the power supply is through a weather-proof plug.

Chipping of Rail Ends Reduced by Beveling

THE beveling of rail ends, which has been a feature of the work of the Electric Railweld Service Corporation, Chicago, in conjunction with its Teleweld process for the restoration of chipped and battered rail ends, has met with so much favor as a means of minimizing the chipping of rail ends, that it is now being extended to include rail recently laid.

It is a common observation that newly laid rail passes through a period of initial cold rolling when there is generally a flowing of metal at the rail ends, which metal, through constant expansion and contraction of the rails, soon breaks or chips out. By removing this overhang at an early stage and by giving the rail ends a bevel, it is said that this chipping is practically eliminated.



Two Views of the Same Joint Before and After Being Beveled and Slotted

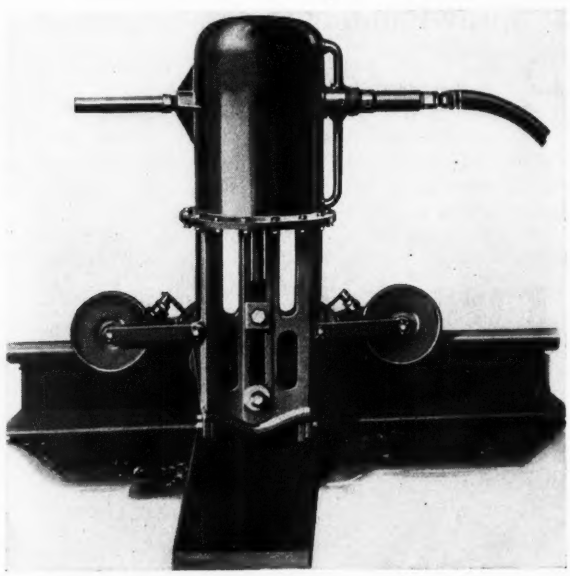
The apparatus which has been developed for doing this work, independent of joint-welding operations, consists of a small track car weighing approximately 600 lb., on which is mounted a gasoline-driven generator unit for supplying power to two electric grinders. The grinders have ⅛-in. stones and apply a cut of $\frac{1}{16}$ in. on each rail end, beveling at an angle of approximately 45 deg. The stones, together with the motors which drive them, are encased in steel frames and are secured in a rigid position during the operation to insure a true and perfect cut. It is said that with this equipment two track miles of rail may be beveled and slotted in a day, requiring the services of three men and costing approximately $75 a mile.

It is recommended that this treatment be applied only after the rail becomes cold rolled under traffic, as otherwise the slot and bevel effect on the new soft metal would have a tendency to aggravate early batter. It is further recommended that the work be done during the spring, fall and winter months of the year when the opening between adjoining rails is the maximum.

This method has been employed experimentally by several roads for periods up to three years. On one such road five track miles of rail. were beveled and slotted by the process outlined above and at the same time the rails on an adjoining five miles were left untouched. A recent inspection has showed that the five miles of rails which were beveled and slotted are in good condition, while the rails in the other section are considerably chipped. This treatment is a special patented feature of the Teleweld process which was developed after extensive study and experimentation and which was described in the December, 1927, issue of *Railway Engineering and Maintenance*.

Pneumatic Spike Puller Is Given Carriage Mounting

AN IMPORTANT feature has been added to the pneumatic spike puller of the Ingersoll-Rand Company, New York, in the form of a rail carriage, which relieves the operator from the necessity of carrying the tool along the track from spike to spike. This carriage consists essentially of two flanged wheels, one in advance of the tool and the other behind it, when in operating position, which are mounted on backets, which have hinged connections to the lower frame of the tool. The weight of the spike puller rests on a spring, the opposite ends of which transmit the load directly to the brackets at the wheels.



The Spike Puller Mounted on a Rail Carriage

In this way, when the spike puller carriage is set on the rail, the spike puller itself is merely floated on the carriage, and at such height that the lowest part of the tool just clears the top of the spike heads. Downward pressure by the operator on the top of the tool lowers it into position for engaging and pull-

ing spikes, while release of this pressure raises the tool for movement along the rail. It is said that the mounting of the spike puller has greatly increased the speed with which it can be used and makes it more positive in action.

Orton Develops New Half-Yard Excavator

THE Orton Crane & Shovel Co., Chicago, has developed a new ½-yd. excavator, known as Model 4, which is said to embody a number of improvements over previous models of small excavators. It is equipped with a 40-hp., 4-cylinder gasoline engine which is provided with an accelerator arranged for both hand and foot operation, an electric starter, an oil filter, an air cleaner and other modern accessories.

Power is transmitted by means of a multiple-disc clutch and the transmission shaft is mounted on anti-friction bearings. An enclosed alloy-steel chain with a floating take-up connects the transmission shaft to the

A View of the New Model 4 in Operation

propelling clutch shaft. Power shafts are made of heat-treated, chrome alloy steel, and all high-speed gears have cut teeth with wide faces. By the use of the engine clutch, it is said that the double-jaw propelling clutches can be shifted as easily as a friction clutch of the gear type, and that the traveling speed can be varied from five-eighths mile to three miles per hour. A special main cutout clutch is provided to enable the operator to stop all of the machinery except the propelling mechanism when traveling.

The treads are of the self-cleaning type and are driven by heat-treated, alloy-steel, bushed roller chains on large-diameter hardened sprockets. Each set of treads is provided with coil springs to protect the operating mechanism from undue strains and shocks, and to distribute the weight of the machine uniformly on the shoes when traveling over uneven ground.

Steering is accomplished by a hand wheel in the cab, and brakes are applied to either of two differential shafts. It is said that the machine can be turned in a circle, the radius of which is equal to the center-to-center distance between the treads. The car body is electrically welded throughout and it is claimed that no strains are imposed on the pivot post by the superstructure. A special brake is provided to prevent the shovel from being forced away from the work when the dipper is being crowded.

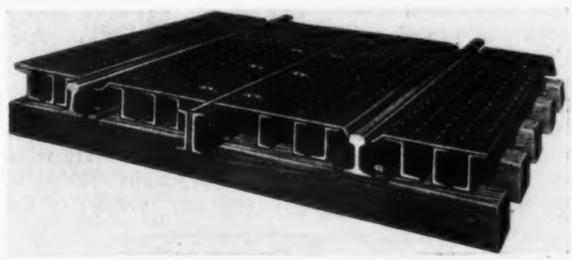
The main hoisting drum gives a single line speed of 160 ft. per min. and the friction clutches are of the double-cone type, equipped with "Orcoin" blocks, which are said to resist heat and moisture. It is also claimed that sluing can be done at a speed of four revolutions per minute. A foot brake is furnished to lock the superstructure in any position.

The shovel is equipped with a 16-ft., electrically-welded boom and a 12½-ft. dipper stick with numerous diaphragms and also electrically welded. The boom hoist is operated by a bronze worm wheel and forged steel worm. A special rope crowd is said to do away with troubles incident to the adjustment of the length of the rope, enabling the dipper to be held in a fully extended position. The normal speed of the crowd is 85 ft. per min., with a thrust on the dipper of 10,000 lb.

An extension of the cab for the operator's position gives a clear view of the work on both sides of the machine and the levers are conveniently located. Each function of the Model 4 is controlled by a separate lever and the control and speeds are arranged so that it is possible to make five trips per minute in regular operation. The Model 4 excavator is convertible to shovel, crane, drag line, ditcher or skimmer, and changes to these attachments can be made in the field.

A New Steel Highway Crossing of Simple Design

JOSEPH T. Ryerson & Son, Inc., Chicago, has recently developed and placed on the market an all-steel highway crossing which embodies several important features. This crossing is constructed of ¼-in. steel plates firmly riveted to longitudinal steel channels and Z-beams which rest on the ties. That part of the crossing on the outside of the rails is held in place by a series of long anchor rods which have hooks on one end and rail clips on the other. A rod



A Section Through the Crossing Showing the Arrangement of the Z-Beams and Channels

is placed in each tie space on the under side of the crossing and the hooked end is inserted in a hole in the external Z-beam, while the end fitted with the rail clip is fastened to the base of the rail on the gage side and tightened to the proper tension.

That part of the crossing between the rails consists of two sets of plates of equal size, each plate being fastened to a longitudinal beam which is spiked to the ties midway between the rails. This beam consists of either a simple I-beam, which is used in case no insulation between the rails is required, or two channels set back to back and separated by a one-inch creosoted timber, this arrangement being used in territory where the rails must be insulated. The bolts holding the two channels together in this case are provided with fiber bushings and washers. The plates between the rails are inserted by placing the flangeway under the ball of the rail and fastening

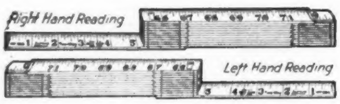
the other side of the plate to the center beam by a number of patented locking devices.

One of the advantageous features claimed for this crossing is its ease of installation, as it is said that four men can install an eight-foot section in less than 30 minutes. The ends of the end plates of the crossing are bent down to the level of the ties to obviate the possibility of dangling chains or air hose becoming caught in the crossing. The plates of the crossing, which have a tread designed to prevent the wheels of vehicles from skidding, are on an exact level with the top of the rail. It is said that these crossings usually remain clear during snow storms as snow does not tend to cling to the cold steel.

An Installation of the New Crossing

A "Two-Way" Folding Rule

A SPRING-JOINT, folding wood rule, known as the Two Way-Red End rule, which embodies several new features in folding rule design, has been developed and placed on the market by the Lufkin Rule Company, Saginaw, Mich. This rule is 5/8 in. wide with 6-in. sections and is made in 4, 5 and 6-ft. lengths. One innovation is the method employed in marking the rule, whereby the figures on one side read from left to right and those on the other side read from right to left, so that the figures are always right side up to the user. It is said that this "two-way" feature of the rule eliminates chances of error and promotes convenience. When completing any measurement where the distance is longer than the rule, the balance of the distance is found by turning the rule over and extending it so that the figures will appear in the right direction and right side up to the user. It is said that the rule is also convenient to commence measuring at either the left or the right end of any object. The rule also has inside markings so that the portion being used lies flat on the work, while the fact that the sixteenths are on the upper instead of the lower edge of the rule is said to be of advantage as they fall nearer to the edge of the work being measured or marked.



The Rule Reads from Either Right or Left

The rule is finished in white enamel and has rust-proof, metal spring joints and trimmings, strike plates to prevent wear of markings in opening and closing, and bright red ends.

With The Associations

The Roadmasters' Association

The executive committee will meet at the Hotel Stevens, Chicago, on Saturday, June 28, to receive and review the reports of the various technical and other committees and to plan for the next annual convention.

Wood Preservers' Association

Members of the executive and other committees of the association will hold their summer meeting jointly with the members of the Wood Preservation committee of the A.R.E.A. at Madison, Wis., on Tuesday and Wednesday, June 10-11. The various committees will meet throughout Tuesday and on Wednesday morning, following which the remainder of the second day will be spent largely in the inspection and study of work in progress at the Forest Products Laboratory. The two groups will join in a dinner on Tuesday evening.

Metropolitan Track Supervisors' Club

The next meeting of the Metropolitan Track Supervisors' Club will be its annual outing, on June 14, to be held at Dorlon's Point, East Norwalk, Conn. Special cars will leave the Grand Central Terminal, New York, at 10 a. m. E. S. T. Special features of the outing will include the election of officers and informal talks by R. R. Nace, chief engineer maintenance of way of the New York Zone of the Pennsylvania; E. E. Oviatt, engineer maintenance of way of the New York, New Haven & Hartford; and P. N. Wilson, superintendent of track, Brooklyn-Manhattan Transit Co.

American Railway Engineering Association

May was a month of considerable activity among the various committees. While most of them had already held meetings for the purpose of organizing their work and assigning subjects to sub-committees, eight committees held general meetings during the month while numerous sub-committees have also met and started actively on the work assigned to them. Among the committees that held general meetings during the month are those on Ballast, at Washington, D. C., on May 8; Iron and Steel Structures, at Cincinnati, Ohio, on May 8-9; Masonry, at Chicago on May 12-13; Records and Accounts, at Washington, D. C., on May 13; Maintenance of Way Work Equipment, at Chicago on May 13; Stresses in Track, at Chicago on May 14; Buildings, at Buffalo, N. Y., on May 20-21; Economics of Railway Operation, at New York, on May 23; and Uniform General Contracts, at Washington, D. C., on May 26. Other committees which are scheduled to meet during June include those on Economics of Railway Labor, at Milwaukee, Wis., on June 9; Water Service and Sanitation, at St. Louis, Mo., on June 9; and Grade Crossings, at Chicago on June 20.

J. V. Neubert, chief engineer maintenance of way, New York Central, and second vice president of the A.R.E.A. attended the International Railway Congress at Madrid, Spain, during May, as a delegate from the American Railway Association.

The board of direction held a meeting at Chicago on May 15 for the transaction of routine business. At this meeting the Palmer House, Chicago, was selected as the meeting place for the next convention, which will be held on March 10-12, 1931.

Railway News  Briefly Told

A "better health" car, equipped with X-ray apparatus and laboratories for physical examinations and for the testing of milk and water, is being operated over the lines of the Southern Pacific to educate the employees in the care of their health. Motion-picture machines with sound reproduction have been installed to project films devoted to nutrition, teeth, posture, blood transfusion, first aid, food and other subjects of health.

Railways operating between Chicago and the Pacific coast have agreed that the fastest passenger schedule between Chicago and Puget Sound shall be 60 hr. and 45 min., a reduction of one hour, westbound, and of 30 min. eastbound, while the fastest schedule between Chicago and California shall be 56 hr. westbound, a reduction of 2 hr., and 57 hr. eastbound, a reduction of 50 min., beginning June 1.

The tree-planting program of the Chicago, Burlington & Quincy, which was commenced in 1928, will be continued this year by the planting of 40,000 trees along the lines of this road west of the Missouri river. In 1928, 7,000 saplings were set out and 38,000 more were planted in 1929. The trees used are American elm, box elder, Russian mulberry, pine and conifers. Eighty per cent of the saplings that have been planted have survived.

The Transcontinental Air Transport, on May 1, began the operation of 24-hr. rail-air service between New York and the southwest with fares slightly less than railroad and sleeping car fares. The schedules provide for travel over the Pennsylvania between New York and Columbus, Ohio; thence over the T. A. T.-Maddux Air Lines to St. Louis, Mo.; and from the latter point by the Southwest Air Fast Express Line. The new service will save about 18 hr. between New York and the southwest as compared with all-rail schedules.

Coincident with the installation of six-hour train service between Montreal, Que., and Toronto, Ont., 334 miles, on April 27, the Canadian National placed in service on one train in each direction telephone connection with the entire Bell system. On the day that the new telephone service was placed on a commercial basis, a special train was operated from Toronto to Montreal, and from this train Sir Henry Thornton, president of the C. N. R., talked with C. J. Smith, vice-president in London, Eng. He also held conversations with officers of the Canadian government at Ottawa, Ont., and with Secretary of Commerce Lamont at Washington, D. C. The new six-hour service, which consists of one train in each direction each day, is the fastest in the world for a comparable distance, the average speed being 55 2/3 m.p.h.

A 4-8-4 type locomotive, all of the axle journals of which are equipped with Timken roller bearings, has recently been constructed by the American Locomotive Company for the Timken Roller Bearing Company, which is using it in tests in both freight and passenger service. It was constructed with the definite objective of demonstrating to the railroads the feasibility of the application of roller bearings to all the axle bearings of a steam locomotive. The locomotive was operated first on the New York Central and is now in service on the Pennsylvania. A total of 52 companies supplied specialties that were applied to the locomotives under a plan which provides for the deferring of payment until it is sold.

A principal feature of the Chicago World's Fair in 1933 will be the transportation exhibit which will depict the development of transportation in all its forms during the last 100 years. This exhibit will be in two principal forms, one of which will be in the nature of a vast pageant featuring all conceivable forms of transportation moving under their own power in front of the reviewing stands, while the other will consist of exhibits open for inspection and contained in the Transportation building. This structure, which will be one of the largest at the fair, will be three stories high and about 1,070 ft. long. It will have two domes, each rising more than 125 ft. into the air and having clear inside diameters of 188 ft. One of these domes will be dedicated to the railroads and the other to the airplane and the exhibits in each dome will vary accordingly. This structure is soon to be started and should be completed some time in the spring of 1931.

Recapture

In a letter addressed to the Committee on Interstate Commerce of the United States Senate on May 17 in response to a request for an expression of opinion on the Howell bill, the Interstate Commerce Commission suggested a number of changes in the recapture provisions of the Transportation Act, providing primarily that: (A) The period for computing recapture be extended from one year to three years, (B) the recapture be so arranged that the carriers' earnings will in no event be drawn down below 6.5 per cent upon the rate base, (C) the recapture plan will be dated from January 1, 1930, with the carriers given the right to elect to have it apply to past years prior to that date.

The Senate of the United States on May 21 adopted Senator Couzens' resolution to suspend until March 4, 1931, the authority of the Interstate Commerce Commission to approve railway unifications except under certain conditions set forth in the resolution. The resolution would also declare unlawful any consolidation or unification or exercise of common control of carriers by railroads in interstate commerce, by holding companies or others, not approved by the commission. It is made clear by an amendment that the resolution is not intended to prohibit the acquisition of short-line railroads. According to the resolution, the commission may approve unification wherein the interests of the employees are protected, where other roads assigned to the same system are acquired and where otherwise there is no violation of the anti-trust laws. The resolution now goes to the House of Representatives.

A joint committee on grade crossing elimination, consisting of representatives of the Operating division and of the Construction and Maintenance, Safety and Signal sections of the A. R. A., has recently been organized. The duties of the new committee are to maintain contact with public authorities in regard to grade crossing protection; to establish contact with other bodies or persons working on the problem of grade crossing protection; to investigate various methods of grade crossing protection and their application; to furnish members with information as to conclusions reached and recommendations made; and to review the work on grade crossing protection of other divisions or sections before it is published. The joint committee is made up of members of the grade crossing committees of the different sections and in each case the chairman of the grade crossing committee was appointed a member of the joint committee. W. J. Towne, chief engineer of the Chicago & North Western, is chairman of the joint committee.

Construction News

Projects Contemplated

Abilene & East.—Examiner's report recommends approval of line, Abilene, Tex., to Cross Plains, 43 miles.

A. T. & S. F.—New yard, San Angelo, Tex., including 10 miles of tracks, yard office, track scales, and water supply system.

B. & O.—Land purchased at Hamilton, Ohio, for construction of addition to yard, total cost $350,000.

C. N. R.—Reached agreement with City of Toronto, Ont., for construction of subways, Gerrard st. and Carlaw ave.; also contemplates subways at De Courcelles, Notre Dame and St. Ambroise sts., Montreal, Que., as part of terminal improvement plan.

G. C. & S. F.—Construction 11-story addition to general office building, Galveston, Tex.

Mexico—Concession granted to Jose M. Sanchez, Mexico City, D. F., for construction of line between Lucrecia, V. C., on Nat. of Mex., to Campeche, Cam., 528 miles, and branch lines beteen Frontera, Tab., and Tonala, Chis., on Nat. of Mex., 230 miles, and between Jalapa, V. C., and Villa Hermosa, 75 miles.

M-K-T.—Applied to Missouri Pub Serv. Com. for authority to construct bridge over Missouri river at Boonville, Mo.

M. P.—Plans submitted by City of St. Louis, Mo., for elimination of grade crossings at Kings Highway blvd., Shaw blvd., De Tonty st. and McRee ave. on Oak Hill branch, $1,200,000. Proposes overhead bridge at Kings Highway blvd. and at Lafayette ave. and to close other crossings.

Nat. of Mex.—Survey completed for line from terminus at El Salto, Dgo., to Mazatlan, Sin., on Pacific ocean, 156 miles, $16,500,000; also plans extension from Tepehuanes, Dgo., to connection with S. P. of Mex. at Culiacan, Sin., 110 miles.

N. Y. Westchester & Boston—Industrial warehouse center having two groups of warehouses at Westchester ave. terminal, White Plains, N. Y.

N. & W.—Fireproof warehouse, 120 ft. by 650 ft., Lambert's Point, Va., $100,000.

Ozark & Philpott Val.—I. C. C. examiner's report recommends approval of new line in Franklin county, Ark., 7 miles.

Approved by Commissions

A. T. & S. F.—By I. C. C., through subsidiaries (Panhandle & S. F., Elkhart & S. F. and Dodge City & Cimarron Val.) to build 380 miles new lines in Texas, New Mexico and Colorado.

C. R. I. & P.—C. R. I. & G.—By I. C. C. to construct new line, Forrest, N. M., to Vega, Tex., 76 miles; C. R. I. & G. to build that part of line in Texas and C. R. I. & P. that part in New Mexico.

C. R. I. & P.—S. L.-S. F.—Plans for new union station, Oklahoma City., Okla., $1,623,000, approved by Okla. Corp. Com.

D. & H.—By Pub. Serv. Com. of N. Y. to eliminate Adams Basin crossing, Ft. Edward, N. Y., by construction of overhead crossing, $92,000.

D. L. & W.—By Pub. Serv. Com. of N. Y. to eliminate Main st. and Plank Road crossings, Richfield Jct., N. Y., by construction of single overhead crossing.

Erie—L. V.—D. L. & W.—By Pub. Serv. Com. of N. Y. to eliminate Ludwig ave. crossing of these roads, Cheektowaga, N. Y., $300,000.

L. V.—By Pub. Serv. Com. of N. Y. to eliminate Seneca turnpike crossing, Canastota, N. Y., by construction of subway, $159,000.

N. Y. C.—By Pub. Serv. Com. of N. Y. to eliminate following grade crossings: Gouverneur-DeKalb state highway and Hayes crossings, DeKalb. Jct., by diverting traffic to new overhead crossing, 925 ft. east, $115,000; Allegheny st. crossing, Corfu, $200,000; Dean crossing, Amawalk, by diverting traffic to new undercrossing 600 ft. southwest, $157,000.

Ore. Elec.—By I. C. C. to construct line from Lebanon, Ore., to Cascadia, 27.4 miles, and three branches: Sweet Home, southeasterly 14 miles; Foster, northeasterly 8.5 miles; and from a point midway between Lebanon and Sweet Home, easterly 5.5 miles; also trackage rights over S. P., Albany, Ore., to Lebanon, 13.6 miles.

Projects Authorized

B. & L. E.—Replacement of steel bridges Nos. 2 and 3, Butler, Pa., by heavier steel bridges, $51,500; replacement of timber trestles Nos. 73 and 75, Conneautville, Pa., by permanent steel and concrete bridges, $30,050; construction of 32-ft. by 114-ft. brick and steel sanitary building and extension of 12-in. steam main, Greenville, Pa., $51,100.

C. P. R.—Reconstruction of roof of old portion of Empress hotel, Victoria, B. C., $600,000. Repair and replacement of 22 bridges on Carmi and Princeton subdivision of Kettle Valley in B. C., including construction of steel bridge between Myra and Ruth to replace 750-ft. timber trestle, 285-ft. steel bridge near Carmi and 450-ft. steel bridge near Ruth, total cost $950,000. Concrete coaling plants of 300 and 150-tons capacity, respectively, Montreal, Que., and Chalk River, Ont.; steel coaling tower, Montreal; new stations at Edmundston, N. B., Ottawa West, Ont., Waldemar and Durham; completion of station, Wakefield, Que.; new turntables, Port McNicoll, Ont., Ingersoll and Cataract; new 40,000 or 60,000-gal. water tanks, Ingersoll, Ont., Grand Valley, Bonfield and Sault Ste. Marie; extensions to sidings or new sidings at ten points in Quebec, Ontario and Vermont.

C. & O.—Track rearrangement, passing siding, coal elevator and cinder conveyor, Elk, W. Va., $185,000; additional tracks account relocation of existing tracks of C. & O. of Indiana, Cincinnati, Ohio, $39,000; replacement of bridge No. 71, Bridgetown, Ohio, $40,000; relocation of tracks serving Camp Stuart, Newport News, Va., $25,300.

Erie—N. Y. C. & St. L.—By Buffalo (N. Y.) Produce Exchange to construct produce terminal adjacent to tracks of these roads at Clinton st. and Bailey ave., includes 50 stores for dealers, cold storage plant, garage and warehouse, bank and winter market; also delivery yard of 350 cars capacity and storage space for 800 more to be built adjacent to terminal.

Bids Received

A. T. & S. F.—Until June 3 for construction of extension between Amarillo, Tex., and Boise City, Okla., 120 miles, as portion of line from Amarillo to Prickett, Tex., 220 miles.

Beav. Meade & Englwd.—Until May 28 for construction of extension from Hough, Okla., west 40 miles.

C. & O.—For construction new passenger station and car parking tracks, White Sulphur, W. Va., $194,700.

Pac. Great East.—For grading of 5.2 miles new line, Lillooet, B. C., to provide entrance into city, total cost $500,000.

Penna.—For construction of 900-ft. to 1,000-ft. pier of steel and concrete at foot of Bay street, Jersey City, N. J., $2,000,000.

Contracts Awarded

A. T. & S. F.—Construction of coal, sand and water facilities, Las Vegas, N. M.—Roberts & Schaefer Co., Chicago. Construction reinforced concrete, steel, brick and stone fire station, 40 ft. by 81 ft., and four-story cafeteria-auditorium, 74 ft. by 120 ft., of same construction, Topeka, Kan.—T. A. Allen Const. Co., Topeka. Also for construction concrete and brick bunk houses, 12 ft. by 120 ft., Emporia Jct., Kan., Gardner, Spencer and Toronto and Marland, Okla., and Waterloo—George Senne Const. Co., Topeka, Kan.

B. & M.—Grade separation structure for Valley Falls - Johnsonville county highway and West st. crossings, Johnsonville, N. Y.—Dalton-Millimet Co., New York, $100,233.

C. N. R.—Subway under tracks, St. Remi st., Montreal, Que.—A. F. Byers & Co., Montreal; substructures of subways at Hibernia and Charlevoix sts., Montreal-Quebec Paving Co., Ltd.; superstructure of latter two subways—Dominion Bridge Co.

C. P. R.—Construction 235 miles branch lines in Sask. and Alta: From Dunelm, Sask., southwest 25 miles—Stewart & Grant, Winnipeg, Man.; Debben-Meadow Lake portion of Prince Albert and Lac la Biche line in Sask., 90 miles—Hett & Sibald, Ltd., Prince Albert, and Tomlinson Const. Co., Winnipeg; from Crossfield, Alta., southwest 30 miles—W. A. Dutton, Winnipeg; at Choiceland, Sask., on Tuffnel-Prince Albert line—F. Mannix, Calgary, Alta.; at Rockglen, Sask.—Foley Bros., Winnipeg, Man.; at Leduc, Alta., and Thorsby—Campbell Const. Co., Calgary; at Sonningdale, Sask.—Roosa & Wickstrand, Winnipeg.

C. & O.—Removing buildings in site between 3rd and 4th and John and Baymiller sts., Cincinnati, Ohio, preparatory to construction six-story freight station and warehouse—Cleveland Wrecking Co., total cost $750,000. Rebuilding arch at bridge No. 4412, Winifrede Jct., W. Va.—Boxley Bros. Co., Orange, Va., $84,500; rebuilding arch over Rush creek, Marmet, W. Va. —Morris, Gray & Hunter, Roanoke, Va., $72,300; rebuilding arch over Lens creek, East Marmet, W. Va.—Reed & Lapsley, Charleston, W. Va., $85,500; extension passing siding, Hurricane, W. Va.—Langhorne & Langhorne, Huntington, W. Va., $101,000; extension center siding, Meadow Creek, W. Va.—West Virginia Const. Co., Huntington, $49,000.

C. & N. W.—Substructures for grade separation structures, Kenosha, Wis.—White Const. Co., Chicago; also for embankment material for one mile of track elevation, Kenosha — Materials Service Corp., Chicago.

C. B. & Q.—Grading of portion of extension to yard, Galesburg, Ill.—Joyce & Co., Keokuk, Iowa.

C. M. St. P. & P.—Construction freight warehouse and office building, Janesville, Wis.—Worden Allen Co., Milwaukee, Wis. Concrete and bridge work, Sections 6 and 7, 13 miles, of joint line with C. R. I & P., Polo, Mo., to Birmingham—Petersen, Shirley & Gunther, Omaha, Neb.

C. St. P. M. & O.—Construction of 35,000-gal. per hr. water softener and storage of 185,000 gal., Mankato, Minn. —Graver Tank & Manufacturing Corp., East Chicago, Ind.

Chi. So. Shore & So. Bend—One-story repair shop, 100 ft. by 200 ft., and office unit, 35 ft. by 100 ft., Michigan City, Ind.—P. H. Lorenz, Moline, Ill., $70,000.

Cin. (Ohio) Union Term.—Laying of 55 miles yard tracks—C. G. Kershaw Contr. Co., Birmingham, Ala.

Day. & Union—Furnishing and erection of steel for grade separation structures in track elevation project, Dayton, Ohio—American Bridge Co., Pittsburgh, Pa., $430,000.

L. V.—Construction of 68,000-gal. per hr. water softener and storage of 150,000 gal., Manchester, N. Y.—Graver Tank & Manufacturing Corp., East Chicago, Ind.

N. Y. C.—Demolition of buildings on Spring and Washington sts. and between 42nd and 43rd sts. and 10th and 11th aves., N. Y.—M. & B. Rosen Co., N. Y.; installation of piping in car shops, Harmon, N. Y.—W. F. Crane & Co., N. Y.; restoration of West 42nd st. passenger terminal, N. Y.—Edward J. Duffy & Co., Inc., N. Y.; elimination of grade crossing, 158th st., N. Y. —P. T. Cox Contr. Co., Inc., N. Y.; reconstruction bridge U-16, Marcy, N. Y.—N. D. Peters & Co., Inc., Utica, N. Y.; elimination grade crossings, Pittsford, N. Y., and Clark st., Auburn, N. Y.—Walsh Const. Co., Syracuse, N. Y.; also elimination of Indian Hill and Bennett crossings, Manchester, N. Y.—Mazzola Barber Const. Co., Buffalo, N. Y., $542,596; reconstruction of bridge carrying South Park avenue, Blasdell, N. Y., over tracks—E. P. Munitz, Inc., Buffalo, $75,556.

N. Y. C. & St. L.—Three-track, 250-ton capacity, reinforced concrete coaling station, Claypool, Ind.—Roberts & Schaefer Co., Chicago.

N. Y. N. H. & H.—Construction of 300-ton reinforced concrete coaling station, Waterbury, Conn.—Roberts & Schaefer Co., Chicago.

Ore. Elect.—Clearing right of way and bridging for first section of extension between Lebanon, Ore., and point in Calapooya River valley, total 30 miles—Hauser Const. Co., Portland, Ore., $200,000.

O. W. R. R. & N.—Passenger station, La Grande, Ore.—Tranchell & Parelins, Portland, Ore., $150,000.

Penna.—New locomotive facilities in 46th st. yard, Philadelphia, Pa.—George A. Fuller Co., Philadelphia; rearrangement of tracks and construction of temporary road between Brilliant, Pa., and Verona, in connection with construction of the Allegheny River blvd. by County of Allegheny, Pa., $67,500. Construction of four-track, 500-ton reinforced concrete automatic electric coaling station, West Philadelphia, Pa. —Roberts & Schaefer Company, Chicago.

P. & W. V.—Erection of superstructure of single-track steel and concrete bridge, 1,500 ft. long and 160 ft. above water, over Youghiogheny river, Jacob's Creek, Pa.—American Bridge Co., Pittsburgh, Pa., $300,000.

Rutland.—Underpass at State highway No. 5485, Mooers Forks, N. Y.—Caledonia Rock Products Corp., Bristol, Vt., $25,500.

Sou.—Construction, 14 miles second track, Williamtown, Ky., to Blanchet, and Sadieville, Ky., to Rogers Gap—Bates & Rogers Const. Co., Chicago.

S. P.—Construction 5.8-mile extension, Sandia, Cal., to Holtville, $195,000. Other contracts as follows: Addition to freight station, Tucson, Ariz.; erection of superstructure of viaduct, Goodyear, Cal.; grading for change of line between Canby, Ore., and New Era; construction of rock-fill dam for reservoir on Bonito creek near Capitan, N. M., $500,000.

S. P. of Mex.—Construction 1,506-ft. deck plate girder extension to bridge over Santiago river between Yago, Noy., and Nanchi—Missouri Valley Bridge & Iron Co., Leavenworth, Kan., $510,000.

T. & P.—Construction 13-story passenger station and office building, Ft. Worth, Tex.—P. O'B. Montgomery, Dallas, Tex.; construction 8-story freight station and inbound warehouse and one-story outbound warehouse at same point—Bellows-Maclay Const. Co., Dallas; construction of reservoir, Annona, Tex.—Allhands & Davis, Joplin, Mo.: installation of direct-steaming system at 23-stall enginehouse, Big Spring, Tex. — Railway Engineering Equipment Co., Chicago.

Tex. Short Line—Grading for extension, between Grand Saline, Tex., and Van, 11 miles—Gifford-Hill & Co., Dallas, Tex.

Tulsa Union Depot — Construction union station, Tulsa, Okla., to be used by S. L.—S. F., A. T. & S. F. and M.-K.-T.—Manhattan Construction Co., Tulsa.

Supply Trade News

General

The Detroit Graphite Company has moved its Chicago sales office to 20 North Wacker drive.

The International Derrick & Equipment Company, Columbus, Ohio, has moved its New York office from 74 Trinity place to 90 West street.

The Tuco Products Corporation has moved its Chicago office from the Railway Exchange building to the Peoples Gas building, 122 South Michigan avenue.

The Electric Railweld Sales Corporation, Chicago, has expanded its welding activities in the railroad field to include the repair and the reinforcement of steel bridges. A special department has been organized to handle this branch of the work, under the direction of **George W. Hettrick,** whose headquarters are in Chicago.

The Union Carbide & Carbon Corporation has consolidated the Kansas City (Mo.) offices of its various units in its new building at 910 Baltimore avenue. The units in the new building include: **The Linde Air Products Company, the Prest-O-Lite Company, Inc., the Oxweld Acetylene Company, the Union Carbide Sales Company, the J. B. Colt Company and the National Carbon Company, Inc.**

Vaughan Tie Tamper Patent Upheld —Judge Hugh Morris of the United States District Court of Delaware, in an opinion handed down April 23, decided the suit of Fanny M. Vaughan and the Ingersoll-Rand Company vs. Gardner-Denver Company, for infringement of the Vaughan tie tamper patent No. 1147660, in favor of the plaintiffs. The Ingersoll-Rand Company is the principal licensee under the patent. It is understood that no appeal from the decision will be made.

The Phoenix Manufacturing Company, Joliet, Ill., has purchased the steel tank, water-treating and steel plate construction business and the plant at East Chicago, Ind., of the **Graver Corporation,** East Chicago, and will operate this plant and business under a wholly-owned subsidiary company to be known as the **Graver Tank & Manufacturing Corporation.** The officers of the new company are: **Edward N. Gosselin,** president; **F. C. Everitt,** vice-president and general manager; **P. S. Graver,** vice-president in charge of sales; **W. F. Graver,** vice-president, **H. S. Graver,** vice-president, and **R. E. Meyer,** secretary and treasurer.

The Southern Manganese Steel Company, which has been operated as a subsidiary of the **American Manganese Steel Company,** Chicago Heights, Ill., has now become a part of the parent company and will be operated as the Southern Manganese Steel division. An office has been opened in the Law

and Finance building, Pittsburgh, Pa., in charge of **W. G. Hoffman** who will handle the sale of both manganese steel castings and heat and corrosion-resisting castings. The Southern Manganese Steel Company was formerly represented in the Pittsburgh and Wheeling districts by the **Brooke L. Jarrett Company** and the American Manganese Steel Company by **C. E. Wallander. John H. Coghlan** has been appointed direct representative in the New England states for the sale of manganese steel castings, with headquarters at 92 Broadway, Cambridge, Mass., to succeed **Harrington, Robinson & Co.,** South Boston.

The Carolina Wood Preserving Company, a South Carolina corporation representing the interests of Grant B. Shipley, Pittsburgh, Pa., and J. F. Prettyman & Sons, Charleston, S. C., has purchased the wood-preserving plant of the latter company at Charleston. The officers of the Carolina Wood Preserving Company are: President, **Grant B. Shipley;** vice-president, **E. S. Park,** vice-president of the New England Wood Preserving Company, Boston, Mass.; vice-president and general manager, **Thomas J. Thorne,** manager of the wood preserving department of J. F. Prettyman & Sons; secretary and treasurer, **H. W. Wehe** and **Cannon F. Prettyman,** formerly vice-president and general manager, J. F. Prettyman & Sons. Mr. Shipley is president of the Century Wood Preserving Company, Pittsburgh, which, through subsidiary companies operates plants at Nashua, N. H., Newport, Del., Hagerstown, Md., Orrville, Ohio, Broadford Junction, Pa., and Reed City, Mich.

Personal

E. D. Cowlin, formerly manager of the New York office of the **Reliance Manufacturing Company,** Massillon, Ohio, has been appointed general sales manager, with headquarters at Massillon.

E. H. Bollenbacher, 725 Forsyth building, Atlanta, Ga., has been appointed sales representative in the Atlanta district of the **Pennsylvania Pump & Compressor Company, Easton, Pa.**

W. Earle Pashley, advertising manager of the **C. F. Pease Company,** Chicago, has been promoted to second vice-president and assistant sales manager and has been succeeded by **C. D. McCormick,** assistant advertising manager.

F. B. Archibald, vice-president of the **National Lock Washer Company,** Newark, N. J., has moved his office from 50 Church street, New York, to 40 Hermon street, Newark. The offices of this company at the former address have been closed.

John A. Roche has resigned as manager of sales of the **Maintenance Equipment Company,** Chicago, to enter business as a manufacturer's agent, with offices in the McCormick building, Chicago. He is sales representative for the **Prendergast Company,** Marion, Ohio, and the **Stanley H. Smith Company,** Cleveland.

H. L. Miller, formerly chief engineer of the **Buda Company,** Harvey, Ill., has been appointed manager of the electric railway division of the **Pettibone-Mulliken Company,** Chicago.

G. LaRue Masters, sales manager of the **National Lock Washer Company,** Newark, N. J., has been elected vice-president in charge of sales. Mr. Masters was born at Philadelphia, Pa., and was educated in the schools of East Orange, N. J. He entered the employ of the National Lock Washer Company in 1919 and was engaged in sales work in its car window equipment department in the east until July, 1926, when he was placed in charge of the sales of this department for the entire United States and Canada under the direction of the late J. Howard Horn, general sales manager of the company. In 1927 Mr. Masters was promoted to assistant sales manager and since 1929 has served as sales manager.

G. LaRue Masters

Richard L. Foster, assistant general manager of sales of the **American Steel & Wire Company,** Chicago, has resigned to become general manager of sales of the **Wickwire Spencer Steel Company** and its subsidiaries, the **American Wire Fabrics Corporation** and the **Wickwire Spencer Sales Corporation,** with headquarters at New York.

W. E. Collier, district sales manager for the **Republic Iron & Steel Company,** has been appointed district sales manager of the **Republic Steel Corporation,** with headquarters at Cleveland, Ohio. **S. L. Gibbons,** sales manager for the **Central Alloy Steel Corporation,** has been appointed assistant district sales manager of the Republic Steel Corporation, with headquarters also at Cleveland. **W. H. Oliver,** district sales manager for the Republic Iron & Steel Company, has been appointed district sales manager for the new corporation. **T. B. Davies,** sales manager of the Central Alloy Steel Corporation, with headquarters at Syracuse, N. Y., has been appointed district sales manager, with headquarters at Buffalo. **R. V. Jones,** district sales manager of Republic, has been appointed district sales manager at Buffalo. **William Vosmer,** vice-president in charge of sales of the **Donner Steel Company,** has been appointed sales manager of the bar division of the Republic Steel Corporation, with headquarters at Youngstown, Ohio. **L. D. Mercer,** in charge of the sheet sales of the Central Alloy Steel Company, has been appointed sales manager of the sheet division.

George Deeks, president of the Dominion Construction Company, died at Toronto, Ont., on May 1. Mr. Deeks, who was 72 years of age, began his activities as a contractor in the United States, where he assisted in the construction of parts of the Michigan Central and the Illinois Central. His activities in recent years were confined mainly to Canada where he constructed several hundred miles of branch lines for the Canadian National and the Canadian Pacific.

William T. Kyle, who has become president of the **Welding Engineering & Research Corporation,** 30 Church street, New York City, was born on October 18, 1883, at Baltimore, Md. He was educated in various academies and specialized in civil engineering. In 1901 he became an apprentice with the Bell Telephone Company at Philadelphia, Pa., and two years later went with the American Pipe & Construction Co., Philadelphia, as district superintendent on general railroad construction work, remaining there until 1908, when he went with the Duplex Metals Company as sales manager of its New York office and later became general sales manager. He was later associated for two years with the Okonite Company as special representative at New York. He then entered business for himself with offices in New York and Chicago. When the Page Steel & Wire Co. was taken over by the American Chain Company, Bridgeport, Conn., Mr. Kyle became general sales manager of this branch of the American Chain Company, with headquarters at Bridgeport. Mr. Kyle has resigned from this position to take up his duties with the Welding Engineering & Research Corporation.

William T. Kyle

Personal Mention

General

Rufus S. Claar, resident engineer on the Minneapolis, St. Paul & Sault Ste. Marie, has been appointed right-of-way and real estate agent of that road and the Duluth, South Shore & Atlantic, wth headquarters as before at Minneapolis, Minn., to succeed **J. E. Westlake,** who resigned to engage in other business.

C. L. Fero, mechanical supervisor on the Delaware, Lackawanna & Western with headquarters at Elmira, N. Y., has left that road to become supervisor of work equipment on the Boston & Maine, with headquarters at Boston. Mr. Fero, who will report to the engineer maintenance of way, succeeds **I. N. Benson,** resigned. **L. C. Ingersoll,** mechanical supervisor on the eastern half of the Lackawanna, has been given jurisdiction over the entire road with headquarters at Scranton, Pa.

H. J. McCall, trainmaster-roadmaster on the Dakota division of the Northern Pacific, with headquarters at Mandan, N. D., whose promotion to trainmaster on the Pasco division was noted in the May issue, was born on June 8, 1885, at Minneapolis, Minn. He was graduated from the University of Minnesota in 1908, with a degree in civil engineering and entered the engineering department of the Northern Pacific on June 15, 1908. On January 1, 1912, after rising through various positions in the engineering department, he was promoted to roadmaster on the St. Paul division, with headquarters at St. Paul, Minn. On December 1, 1922, he was sent to the Dakota division, with headquarters at Jamestown, N. D., as division roadmaster, being then promoted to trainmaster-roadmaster, with headquarters at Mandan, on May 15, 1928. His promotion to trainmaster, with headquarters at Pasco, Wash., became effective on April 1.

J. S. McMillan, formerly connected with the engineering department of the St. Louis-San Francisco and more recently assistant superintendent of the River division of that road, with headquarters at Chaffee, Mo., has been promoted to superintendent of that division, with the same headquarters, to succeed **J. A. Moran,** transferred. Mr. McMillan is only 30 years of age and was born at Canandaigua, N. Y. He enlisted with the United States Marines at the age of 16 and served more than two years in France during the World war. In March, 1920, following his discharge from the army, he entered railway service as a chainman in the engineering department of the Northern division of the St. Louis-San Francisco, with headquarters at St. Louis, Mo. He later became a rodman and in 1922 he was promoted to transitman. In 1925, he was in charge of the construction of a cutoff between Brownington, Mo., and Deep Water, and on January 1, 1926, he was promoted to assistant superintendent of the River division, with headquarters at Chaffee. His promotion to superintendent became effective on April 1.

George D. Brooke, an engineer by training and experience and general manager of the Chesapeake & Ohio, with headquarters at Richmond, Va., has been appointed vice-president and general manager in charge of operation of the Chesapeake & Ohio Lines, with the same headquarters. **R. N. Begien,** vice-president in charge of operation, engineering and construction of the Chesapeake & Ohio, remains in charge of engineering and construction, with headquarters at Richmond, Va.

Mr. Brooke was born on September 15, 1878, at Sutherlin, Va., and was graduated from the Virginia Military Institute in 1900. He entered railway service on July 17, 1902, as a rodman on the Baltimore & Ohio and was promoted successively to levelman, transitman and assistant engineer in charge of field work and location surveys. He was promoted to assistant division engineer, with headquarters at Pittsburgh, Pa., in 1908 and to division engineer, with headquarters at Baltimore, Md., in July, 1909, in which position he remained until March, 1911, when he was made assistant engineer in the operating department. He was promoted to assistant superintendent, with headquarters at Keyser, W. Va., in February, 1912, and to superintendent in September of the same year, serving in this capacity on various divisions until May, 1918, when he was appointed special representative of the transportation department, with headquarters at Baltimore, Md. In July, 1918, he was appointed supervisor in the operating division of the United States Railroad Administration, with headquarters at Philadelphia, Pa., remaining in that position until March, 1919, when he returned to the Baltimore & Ohio as superintendent of transportation, with headquarters at Cincinnati, Ohio. On August 1, 1924, he was appointed assistant to the vice-president in charge of operation of the Chesapeake & Ohio, with headquarters at Richmond, Va., and in October, 1926, he was appointed general manager, which position he held until his recent appointment as vice-president and general manager. Mr. Brooke is also president of the American Railway Engineering Association, having been elected to that position at the annual convention in March.

George D. Brooke

Engineering

W. Y. Ware, office engineer on the Atchison, Topeka & Santa Fe, with headquarters at Chillicothe, Ill., has been appointed assistant engineer with headquarters at Streator, Ill.

E. G. Day has been appointed division engineer of the Peninsula division of the Chicago & North Western, with headquarters at Escanaba, Mich., to succeed **G. Loughnane,** who has retired.

R. W. E. Bowler, division engineer of the Pittsburgh division of the Pennsylvania, with headquarters at Pittsburgh, Pa., has had his jurisdiction extended to include the Cresson division, which is now part of the Pittsburgh division.

M. M. Churchill, division engineer on the Canadian National, with headquarters at Kamloops, B. C., has been transferred to the Edson division, with headquarters at Edson, Alta., to succeed **W. E. Rivers,** whose transfer to Prince Albert, Sask., was noted in the April issue.

E. V. Juday, assistant engineer on the Hocking Valley, with headquarters at Columbus, Ohio, has been granted a six-months' leave of absence in order to accept a position as resident engineer on the Pere Marquette, with headquarters in the vicinity of Benton Harbor, Mich.

R. G. Bush, division engineer of the Kansas City Terminal division of the Missouri Pacific, with headquarters at Kansas City, Mo., has been transferred to the Omaha and Northern Kansas divisions, with headquarters at Falls City, Neb., to replace **F. A. Jones,** who has been transferred to Kansas City to succeed Mr. Bush.

In connection with the recent consolidation of the Delaware and Norfolk divisions of the Pennsylvania to form the new Delmarva division of that road, **W. R. Parvin,** division engineer of the old Norfolk division, has been made division engineer of the new division, with headquarters at Cape Charles, Va. **A. L. Detweiler,** assistant to the division engineer on the Norfolk division, has been appointed assistant to the division engineer on the new division.

E. E. Foster, division engineer on the Minneapolis, St. Paul & Sault Ste. Marie, with headquarters at Stevens Point, Wis., has been appointed resident engineer, with headquarters at Minneapolis, Minn., to replace **W. H. Stedji,** who succeeds **Rufus S. Claar** as

resident engineer, with the same headquarters. The promotion of Mr. Claar to real estate and right of way agent is noted elsewhere in these columns.

A. F. Reiland has been appointed grade crossing engineer on the Delaware, Lackawanna & Western, with headquarters at Buffalo, N. Y., to handle the work of **D. R. Young,** assistant engineer, who has been promoted to division engineer, with headquarters at the same place, to succeed **F. L. Wheaton,** who has retired.

William Michel, chief engineer of the Hocking Valley, with headquarters at Columbus, Ohio, has been appointed chief engineer of the advisory committee on ways and structures of the Chesapeake & Ohio, with headquarters at Cleveland, Ohio. The appointment of Mr. Michel comes as a result of the merging of the Hocking Valley into the Chesapeake & Ohio, the Hocking Valley will be operated as the Hocking division of the General Western division of the Chesapeake & Ohio. **W. L. Roller,** engineer maintenance of way of the Hocking Valley, has been appointed division engineer of the Hocking division of the Chesapeake & Ohio, with headquarters as before at Columbus, in accord with this plan. **P. B. Snyder** has been appointed assistant division engineer of the Hocking division, with headquarters also at Columbus.

W. Fields, whose promotion to division engineer on the International-Great Northern, with headquarters at San Antonio, Tex., was noted in the May issue, was born on February 25, 1890, at Wellsville, Mo. After attending Central Wesleyan College at Warrenton, Mo., for a short time he entered railway service with the Midland Valley in October, 1910, as a flagman in the engineering department. He served in this capacity and as a rodman until October 30, 1911, when he resigned to become connected with a firm of civil engineers at Houston, Tex., later becoming an instrumentman with the San Benito Land & Water Co. at San Benito, Tex. In October, 1913, he became a levelman on the St. Louis, Brownsville & Mexico (now part of the Missouri Pacific), but resigned in March, 1914, to join the engineering department of Harris county, Tex. He was later connected with the Beaumont Shipbuilding & Dry Dock Co. as an assistant engineer. In October, 1917, Mr. Fields re-entered railway service with the Gulf Coast Lines (now part of the Missouri Pacific) as an assistant engineer. From February 1, 1918, to August 15, 1919, he was with the United States Army, returning to the Gulf Coast Lines on the latter date as a pilot and assistant engineer, with headquarters at Houston, Tex. In August, 1924, he was promoted to roadmaster, with headquarters at Kingsville, Tex., and in July, 1925, he was appointed office engineer with headquarters at Houston, which position he was holding at the time of his promotion to division engineer on the International-Great Northern, effective February 17.

W. R. Bennett, assistant to the president of the Wabash, has been appointed chief engineer maintenance of way, with headquarters as before at St. Louis, Mo. He was born on June 28, 1888, at Peoria, Ill., and after attending Bradley Polytechnic Institute, commenced his railway career as a transitman with the Chicago & Alton in July, 1908. In May, 1909, he went with the Peoria & Pekin Union also as a transitman, later being appointed inspector and assistant engineer on bridge construction. After serving as assistant city engineer of Peoria, Ill., from February, 1913, to November, 1914, he entered the service of the Atchison, Topeka & Santa Fe advancing successively through the positions of draftsman, transitman, engineer, accountant, as-

W. R. Bennett

sistant chief clerk to the superintendent and valuation accountant. In October, 1918, he went with the Wabash as assistant division engineer of the Detroit division. Mr. Bennett was appointed track supervisor in November, 1919, and roadmaster of the Chicago Terminal division in April, 1921. In October of the latter year, he was made assistant engineer being promoted to division engineer at Springfield, Ill., in October, 1923. He was promoted to assistant chief engineer at St. Louis three years later and in March, 1929, he was promoted to assistant to the president at the same point. His promotion to chief engineer maintenance of way became effective on May 16.

A. I. Gauthier, whose promotion to assistant division engineer on the Boston & Maine, with headquarters at Concord, N. H., was noted in these columns of the May issue, was born on June 2, 1887, at Cornwall, Ont., and after receiving his education in a high school and later in a preparatory school, he entered the service of the Boston & Maine as a rodman in the engineering department in 1907. In December of that year he left the railroad, and for the next 15 months he worked in the office of the city engineer of Lowell, Mass., as a rodman and transitman. On April 1, 1909, he returned to the Boston & Maine as a rodman in the construction department and was later advanced to transitman and to assistant engineer. In October, 1911, he was transferred to the bridge and building department as assistant supervisor of bridges and buildings on the W. N. & P. division, and on July 1, 1914, he was promoted to supervisor of bridges and buildings on the Terminal division, with headquarters at Boston, Mass. On January 15, 1915, he was transferred to the Southern division, at Concord, N. H., where he was located at the time of his recent promotion to assistant division engineer.

J. S. Gillum, whose promotion to assistant division engineer on the Pennsylvania, with headquarters at Lancaster, Pa., was noted in these columns of the May issue, was born on February 12, 1893, at Terre Haute, Ind., and received his higher education at Rose Polytechnic Institute, from which he was graduated in 1914. He entered railway service in November, 1915, as an assistant on the engineering corps of the St. Louis division of the Pennsylvania, and in April, 1917, he left the railroad to serve in the United States Army with the rank of second and first lieutenant of engineers. On his return to the Pennsylvania in September, 1919, he resumed his former position on the engineering corps of the St. Louis division, and in June, 1923, he was transferred to the Columbus division. In November, 1926, he was promoted to assistant supervisor on the Middle division, and in April, 1927, he was transferred to the Philadelphia Terminal division. In July, 1928, he was promoted to supervisor of the Trenton division and in November of that year he was transferred to the Philadelphia division, where he was located at the time of his recent promotion to assistant division engineer.

Track

Tony Zangar has been appointed roadmaster on the Northern Pacific, with headquarters at Spokane, Wash., to succeed **Andrew Larson,** who has been granted an indefinite leave of absence.

John Tangney, roadmaster on the Southern Pacific, with headquarters at Niles, Cal., has retired after nearly 43 years service with that road. **C. N. Myrick,** roadmaster, with headquarters at Suisin, Cal., has been transferred to Niles to replace Mr. Tangney.

W. D. Norris, section foreman on the Chicago, Rock Island & Pacific, with headquarters at Liberal, Kan., has been promoted to assistant roadmaster, with headquarters at Gruver, Tex., to succeed **Paul M. Guyer,** who has resigned to engage in other business.

G. W. Kostiuk, roadmaster on the Lethbridge division of the Canadian

Pacific, with headquarters at Macleod, Alta., has been transferred to the Moose Jaw division, with headquarters at Shaunavon, Sask., where he replaces **W. Christianson,** who has in turn been transferred to Macleod.

As a result of the consolidation of the Delaware and Norfolk divisions of the Pennsylvania, **F. H. Lewis,** division engineer of the Delaware division, has been appointed supervisor of track at Huntingdon, Pa., succeeding **J. H. Otto,** who has been assigned to special duty on the Middle division.

F. J. Coates, supervisor of track on the Tennessee division of the Illinois Central, with headquarters at Dyersville, Tenn., has been transferred to Christopher, Ill., to replace **P. H. Croft,** who has been transferred to Centralia, Ill., where he succeeds **J. H. Miller,** who has been assigned to other duties.

J. A. Bryan, whose promotion to division roadmaster on the Northern Pacific, with headquarters at Spokane, Wash., was noted in the May issue, first entered railway service on May 10, 1907, with the Chicago Great Western as a clerk in the superintendent's office at Des Moines, Iowa. A year later he resigned to become connected with the Northern Pacific, with which company he served successively as a clerk in various division offices, freight brakeman, extra gang and section foreman, assistant roadmaster and roadmaster. During the World war he served for two years with the 13th Engineers of the United States Army in France. His promotion to division roadmaster became effective on April 1.

R. E. Mattson, who has been promoted to roadmaster on the Fargo division of the Northern Pacific, with headquarters at Fargo, N. D., as noted in the May issue, was born on March 24, 1901, at Minneapolis, Minn. He received his education at the United States Naval Academy and at the Massachusetts Institute of Technology, and in August, 1926, almost immediately after leaving the latter school, he entered the service of the Northern Pacific as a track apprentice at Duluth, Minn. In April, 1927, he was promoted to assistant roadmaster, with the same headquarters, being appointed assistant supervisor of bridges and buildings at Fargo, N. D., in December, 1927. He was holding the latter position at the time of his promotion to roadmaster, effective April 1.

Loren L. Davis, assistant track supervisor on the Boston & Maine, with headquarters at White River Junction, Vt., has been promoted to track supervisor in charge of a newly created district, with headquarters at Bellow Falls, Vt. **Leonard V. Barrett,** assistant track supervisor, with headquarters at Lowell, Mass., has been appointed track supervisor of District No. 3, with headquarters at Concord, N. H., but, temporarily, will continue in charge of the ballasting operations on the Fitchburg division. **Oscar C. Benson,** acting assistant track supervisor on the Southern division, with headquarters at Lowell, has been appointed acting track supervisor on District No. 3 at Concord, filling the vacancy caused by Mr. Barrett's continued assignment to the ballasting work on the Fitchburg division. **Milton E. Leavitt** has been made assistant track supervisor on District No. 3, with headquarters at Portsmouth, N. H.

C. W. Coil, whose promotion to trainmaster-roadmaster on the Dakota division of the Northern Pacific, with headquarters at Mandan, N. D., was noted in the May issue, was born on May 22, 1892, at Spencerville, Ohio. After spending two years at the State University of Ohio, he entered railway service with the Northern Pacific on October 1, 1911, as a clerk in the office of the treasurer at St. Paul, Minn. On May 1, 1913, he was transferred to the engineering department, where he served as a chainman and rodman until January 1, 1917, when he was promoted to assistant roadmaster, with headquarters at Minneapolis, Minn. On July 1, 1919, he was further promoted to roadmaster on branch lines at Mandan, N. D., and on June 1, 1921, he became a roadmaster on the main line of the Yellowstone division, with the same headquarters, being then transferred successively to Missoula, Mont., and Helena. On July 1, 1928, he was promoted to division roadmaster of the Fargo division, with headquarters at Fargo, N. D., which position he was holding at the time of his recent promotion, effective April 1.

Ora Miller, roadmaster on the Chicago, Milwaukee, St. Paul & Pacific, with headquarters at Mobridge, S. D., has been transferred to the Middle division, with headquarters at Marion, Iowa, to replace **F. Kovaleski,** who has been transferred to St. Paul, Minn. **Roy Minton,** section foreman on the Wisconsin Valley division, with headquarters at Minocqua, Wis., has been promoted to roadmaster on the Dubuque division to succeed **Louis Guinn,** who has been appointed general extra gang foreman.

Mr. Minton was born on January 22, 1886, in Waupaca county, Wis., and commenced railway service in April, 1910, as a trackman on the Chicago, Milwaukee, St. Paul & Pacific. Three years later he was promoted to track foreman and in 1924 he was further promoted to extra gang foreman, in which capacity he served on the Wisconsin Valley division, the Superior division, the Chicago & Milwaukee division, the Iowa division, the Racine & Southwestern division and the River division. Mr. Minton's promotion to roadmaster became effective on April 1.

R. A. Sharood, whose promotion to roadmaster on the Yellowstone division of the Northern Pacific, with headquarters at Glendive, Mont., was noted in the May issue, was born on February 25, 1904, at St. Paul, Minn. He was educated at St. Thomas Academy, St. Paul, and at Cornell University, receiving a degree in civil engineering from the latter in 1927. He first entered railway service with the Northern Pacific on August 1, 1927, as a chainman in the engineering department, with headquarters at Jamestown, N. D. On October 12 of the same year, he was transferred to construction work in connection with the revision of the line between Florence, Mont., and Hamilton, being promoted to rodman on the same project on April 1, 1928. Seven months later he went to the Rocky Mountain division as a track man and on March 4, 1929, he was promoted to foreman on one of the system rail-laying gangs, which position he held until August 23, when he again became a track man on the St. Paul division. On February 16 of this year, he resumed the position of foreman on the system rail-laying gang, which position he was holding at the time of his promotion to roadmaster, effective April 1.

C. T. Stratford, assistant on the engineer corps of the Pittsburgh division of the Pennsylvania, has been promoted to assistant supervisor on the Renovo division to succeed **F. S. Bowden,** who has been transferred to the Panhandle division, with headquarters at Dennison, Ohio, where he replaces **M. C. Bitner,** who has been promoted to supervisor on the Renovo division, with headquarters at Warren, Pa. Mr. Bitner succeeds **F. W. Kittelberger,** who has been transferred to the Cleveland division, with headquarters at Wellsville, Ohio, to replace **G. M. Sauvain,** who has been transferred to the Eastern division, with headquarters at Wooster, Ohio, succeeding **F. G. Church,** whose promotion to assistant division engineed was noted in the May issue.

Mr. Bitner was born on January 31, 1900, at Du Bois, Pa., and was educated at the Carnegie Institute of Technology, receiving a degree in civil engineering in 1925. He began his railway career with the Pennsylvania on May 1, 1926, as assistant on the engineer corps of the Panhandle division, being promoted to assistant supervisor on the Renovo division at Kane, Pa., on May 1, 1928. Mr. Bitner remained at Kane until January 10, 1929, when he was transferred to the Panhandle division, with headquarters at Dennison, Ohio. His promotion to supervisor became effective on April 1.

Bridge and Building

E. V. Morris, bridge and building foreman on the Dakota division of the Northern Pacific, has been promoted to assistant bridge and building supervisor, with headquarters at Fargo, N. D., to succeed **R. E. Mattson,** whose promotion to roadmaster was noted in the May issue.

W. T. Hutton, assistant supervisor of bridges and buildings on the Cumberland Valley division of the Louisville & Nashville, with headquarters at

Middlesboro, Ky., has been promoted to supervisor of bridges and buildings, with the same headquarters, to replace **Harlan Leech,** whose death is noted elsewhere in these columns.

O. W. Stephens has been appointed bridge and building supervisor on the Delaware & Hudson to succeed **J. H. Phillips,** who has been promoted to bridge and building master on the Saratoga division, with headquarters at Green Island, N. Y., where he replaces **C. M. Burpee,** who has been assigned to other duties.

H. L. Forney, whose retirement as master carpenter on the Pittsburgh division of the Baltimore & Ohio, was noted in these columns of the May issue, entered the service of the B. & O. on March 1, 1887, on the Connellsville division, but left on November 9, 1888, to enter other business. He re-entered the service as a carpenter on the Connellsville division on August 1, 1893, and was promoted to carpenter foreman on March 10, 1894, which position he held until May 1, 1896, at which time he was appointed building inspector. On June 1, 1898, he was again appointed carpenter foreman and on November 4, 1908, he went to the New Castle division as master carpenter, with headquarters at New Castle, Pa., then going to the Pittsburgh division as a carpenter on April 20, 1916. On February 1, 1917, Mr. Forney was promoted to master carpenter at Pittsburgh, Pa., which position he held until his retirement, effective February 5.

F. C. Bernard, whose promotion to supervisor of bridges and buildings on the Missouri Pacific, with headquarters at Monroe, La., was noted in the April issue, was born on October 22, 1871, at Grand Rapids, Mich., and attended college for two years. He began railway service with the New York, Chicago & St. Louis in August, 1897, and from 1898 to 1899 he served as a fireman and brakeman on the Hocking Valley, leaving this road in 1900 to join the Wheeling & Lake Erie. From 1902 to 1904, Mr. Bernard was superintendent of bridge and building work for the Babcock Construction Company and from 1905 to 1906 he was resident engineer for the McMane Dock Construction Company, with headquarters at New Orleans, La. In 1906 he became a pile driver engineer on the Wheeling & Lake Erie, which position he held until 1909, when he was appointed senior foreman on the Missouri-Kansas-Texas. He was appointed pattern carpenter foreman on the Missouri Pacific in 1912 and a year later he became a foreman of bridges and buildings, which position he held until his recent promotion.

Obituary

Martin Kane, formerly master painter on the Delaware & Hudson, died at his home in Albany, N. Y., on May 14 at the age of 75 years.

Oliver E. Hallett, engineer on the Harlem division of the New York Central, died on May 8, at White Plains, N. Y., in his seventieth year.

J. Z. Choate, who retired as bridge and building master on the Canadian Pacific two years ago, died at his home at Vancouver, B. C., on May 5 at the age of 67 years.

W. M. Robinson, president and general manager of the Augusta & Somerville, with headquarters at Augusta, Ga., died at his home in that city on April 17 at the age of 82 years. Mr. Robinson had formerly served as supervisor of track and roadmaster on the Georgia Railroad and in 1914 he was appointed valuation engineer of the Georgia Railroad & Banking Company. He had been president and general manager of the Augusta & Somerville since 1920.

Harlan Leech, bridge and building supervisor of the Cumberland Valley division of the Louisville & Nashville, with headquarters at Middlesboro, Ky., died at his home in that city on April 9 after an illness of about two weeks. Mr. Leech had been in the service of the Cumberland Valley division of the L. & N. for more than 39 years, which was his entire span of service with that road. He was born on February 14, 1857, in Rockbridge county, Va., and entered the service of the L. & N. at Middlesboro as a bridge and building carpenter on January 21, 1891. On August 1, 1907, he was promoted to the newly created position of supervisor of bridges and buildings of the Cumberland Valley division.

Albion L. Grandy, assistant to the vice-president and formerly chief engineer of the Pere Marquette, with headquarters at Detroit, Mich., died at his home in that city on May 3 following a heart attack. He was born at Barton's Landing (now Orleans), Vt., in 1867, and graduated from St. Johnsbury

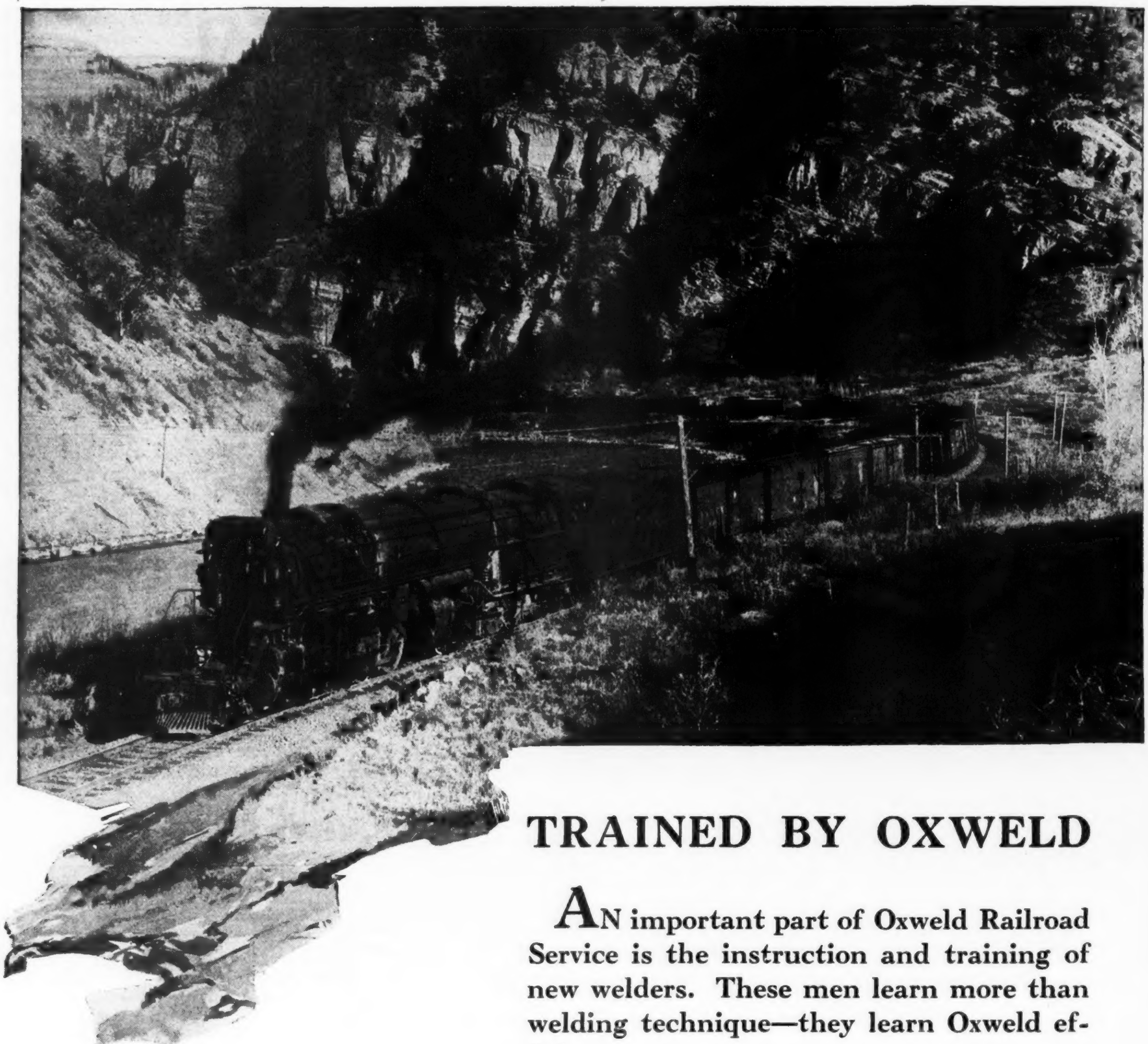
Albion L. Grandy

Academy in 1884. He commenced his railway career with the Frankfort & South Eastern (now part of the Ann Arbor) and in 1889, he joined the engineering staff of the Chicago & West Michigan and the Detroit, Grand Rapids & Western (both now parts of the Pere Marquette). He served with these two roads as an assistant engineer and in 1900 he was appointed track supervisor on the Erie, with headquarters at Akron, Ohio. In 1905, Mr. Grandy was appointed division engineer on the Pere Marquette, with headquarters at Saginaw, Mich., where he remained until 1912, when he was promoted to chief engineer with headquarters at Detroit. He was further promoted to assistant general manager at Detroit in 1917, and then assistant to the president and general manager in 1922. Since 1929 Mr. Grandy had been assistant to the vice-president.

Albert H. Hogeland, consulting engineer of the Great Northern, with headquarters at St. Paul, Minn., died at

Albert H. Hogeland

Rochester, Minn., on May 14 after an illness of two months. He had been engaged in railway engineering work in the Northwest for 51 years, nearly 45 of which had been spent with the Great Northern. He was born on January 10, 1858, at Southampton, Pa., and graduated from Lafayette College in 1877, with a degree in civil engineering. In April, 1879, he entered railway service as a rodman on the St. Paul & Pacific (now part of the Northern Paccific) and was subsequently advanced to levelman, transitman and topographer on location on the Northern Pacific. From 1882 to 1885, he served as assistant engineer on the construction of the Bozeman tunnel of the Northern Pacific, on the St. Paul, Minneapolis & Manitoba (now part of the Great Northern) in North Dakota and on the construction of the Wisconsin division of the Northern Pacific. He was then appointed assistant engineer of construction and maintenance of the St. Paul, Minneapolis & Manitoba and Great Northern lines in Minnesota, North Dakota and Montana, which position he held until September, 1890, when he was advanced to engineer maintenance of way of the Eastern district of the latter road, with headquarters at St. Paul. In 1896, Mr. Hogeland was appointed resident engineer and in 1902 assistant chief engineer, being further promoted to chief engineer in 1903. He was appointed consulting engineer in May, 1925.



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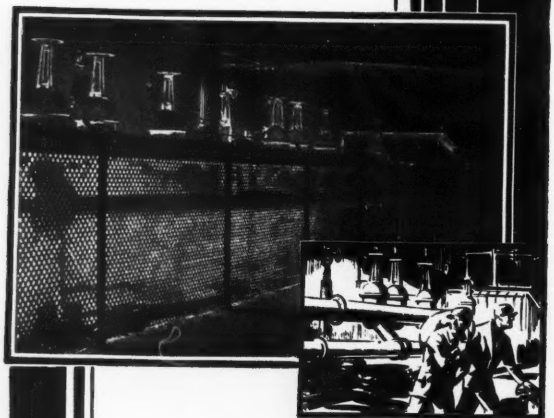

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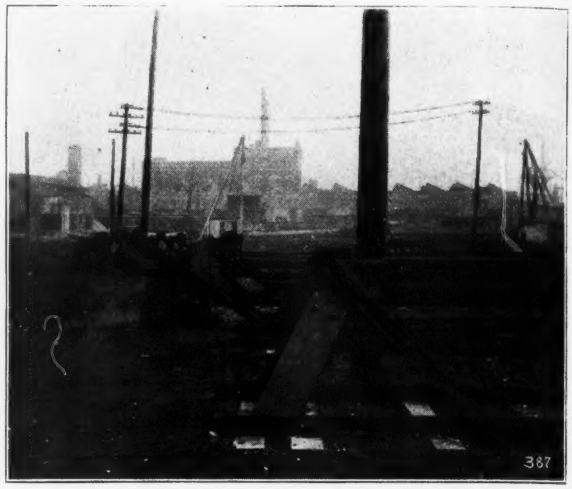

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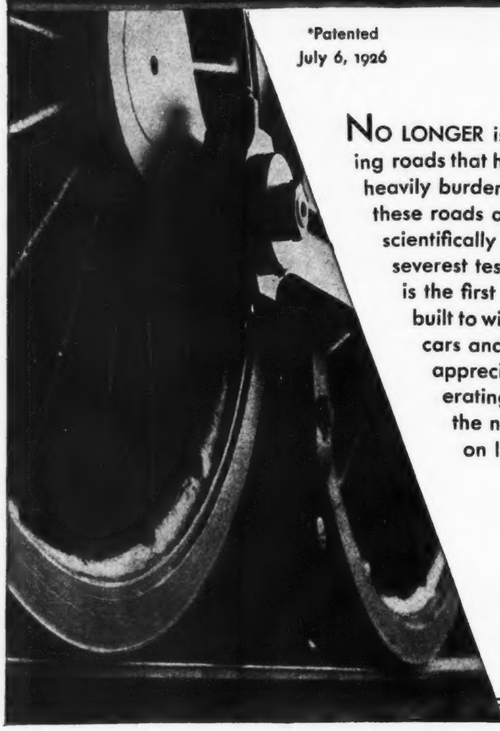

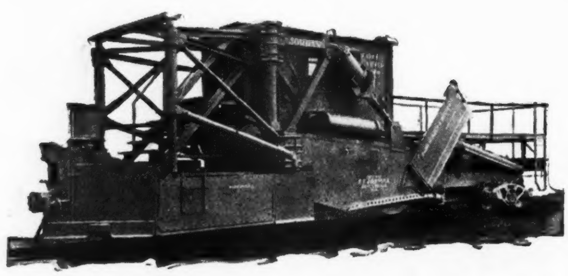

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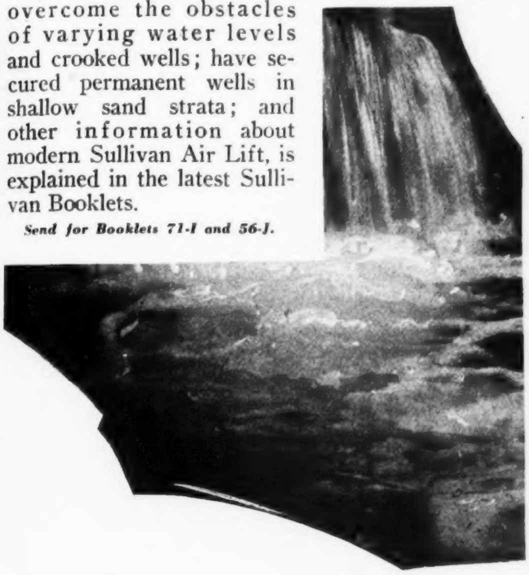

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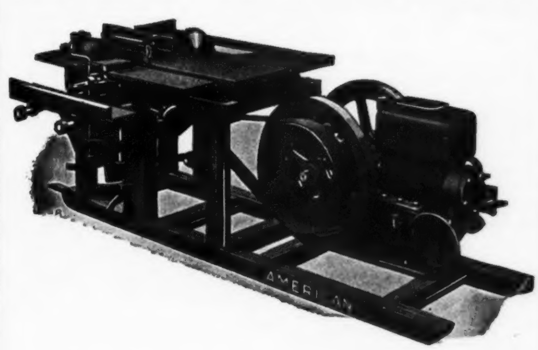

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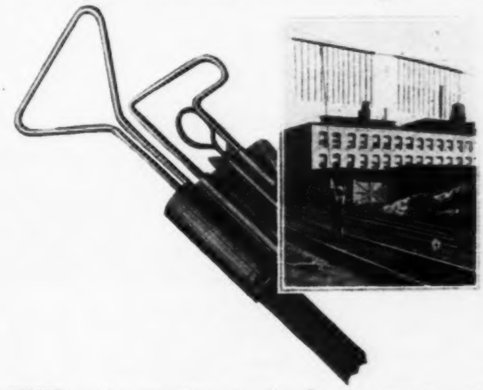

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Fairbanks, Morse & Co.

Stands, Switch & Target
Bethlehem Steel Co.
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Q. & C. Co.

Steam Enclosures
Toncan Culvert Mfrs. Assn.

Steam Shovels
Bucyrus-Erie Co.
Harnischfeger Corp.
Northwest Engineering Co.
Orton Crane & Shovel Co.

Steel, Alloy
Central Alloy Steel Corp.
Illinois Steel Company

Steel Cross Ties
Carnegie Steel Co.

Steel, Electric Furnace
Timken Roller Bearing Co.

Steel Frame Houses
Butler Mfg. Co.

Steel, Open Hearth
Carnegie Steel Co.
Timken Roller Bearing Co.

Steel Plates and Shapes
Bethlehem Steel Co.
Carnegie Steel Co.
Illinois Steel Company

Steel, Special Analysis
Timken Roller Bearing Co.

Storage Tanks
Chicago Bridge & Iron Works
Graver Corp.
Pittsburgh-Des Moines Steel Co.

Storm Sewers, Corrugated Iron
Armco Culvert Mfrs. Assn.

Stream Enclosures, Corrugated Iron
Armco Culvert Mfrs. Assn.

Street Culverts, Part Circle
Armco Culvert Mfrs. Assn.
Toncan Culvert Mfrs. Assn.

Structural Steel
Bethlehem Steel Co.
Carnegie Steel Co.
Illinois Steel Company

Switch Guard
Ramapo Ajax Corp.

Switchmen's Houses
Massey Concrete Products Corp.

Switches
Bethlehem Steel Co.
Buda Co.
Ramapo Ajax Corp.
Wharton Jr. & Co., Wm.

Switchpoint Protectors
Maintenance Equipment Co.

Switchpoint, Reconditioning
Morrison Railway Supply Corp.

Switchstands & Fixtures
Bethlehem Steel Co.
Buda Co.
Ramapo Ajax Corp.
Wharton Jr. & Co., Wm.

Tampers, Tie
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Chicago Bridge & Iron Works

Tanks, Oil Storage
Chicago Bridge & Iron Works
Graver Corp.

Tanks, Roadside Delivery
Chicago Bridge & Iron Works

Tanks, Steel
Chicago Bridge & Iron Works
Graver Corp.
Pittsburgh-Des Moines Steel Co.

Tapes, Measuring
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American Telephone & Telegraph Co.

Telephone Service, Long Distance
American Telephone & Telegraph Co.

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Tie Plate Clamps
Q. & C. Co.

Tie Plates
Bethlehem Steel Co.
Illinois Steel Co.
Lundie Engineering Corp.

Tie Rods
Bethlehem Steel Co.
Coover Railroad Track Brace Co.

Tie Scorer
Woolery Machine Co.

Tie Spacers
American Chain Co., Inc.
Maintenance Equipment Co.

Tie Tampers
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Southern Wood Preserving Co.

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Oxweld Railroad Service Co.

Tools, Pneumatic
Chicago Pneumatic Tool Co.
Gardner-Denver Co.
Independent Pneumatic Tool Co.
Ingersoll-Rand Co.

Tools, Track
Buda Co.
Maintenance Equipment Co.
Q. & C. Co.
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Woodings Forge & Tool Co.

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Buda Co.
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Wharton Jr. Co., Wm.

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Cullen-Friestedt Co.
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Kalamazoo Railway Supply Co.
Verona Tool Works

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Chicago Bridge & Iron Works
Pittsburgh-Des Moines Steel Co.

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Oxweld Railroad Service Co.

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Electric Railroad Sales Corp.

Welding, Oxy-Acetylene
Oxweld Railroad Service Co.

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Armco Culvert Mfrs. Assn.
Toncan Culvert Mfrs. Assn.

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Layne & Bowler, Inc.

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Buda Co.
Fairbanks, Morse & Co.
Fairmont Railway Motors, Inc.
Kalamazoo Railway Supply Co.
Northwestern Motor Co.
Woolery Machine Co.

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Carnegie Steel Co.

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Fairmont Railway Motors, Inc.

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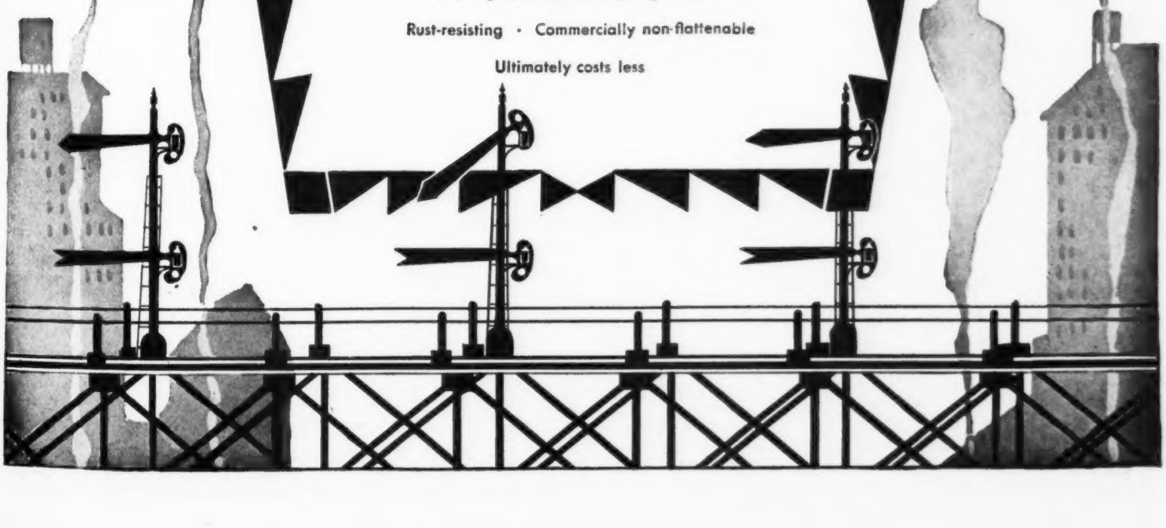

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